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Volume 174 Number 1

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THE WOODS HOLE MARINE BIOLOGICAL LABORATORY

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Frank R. Lillie

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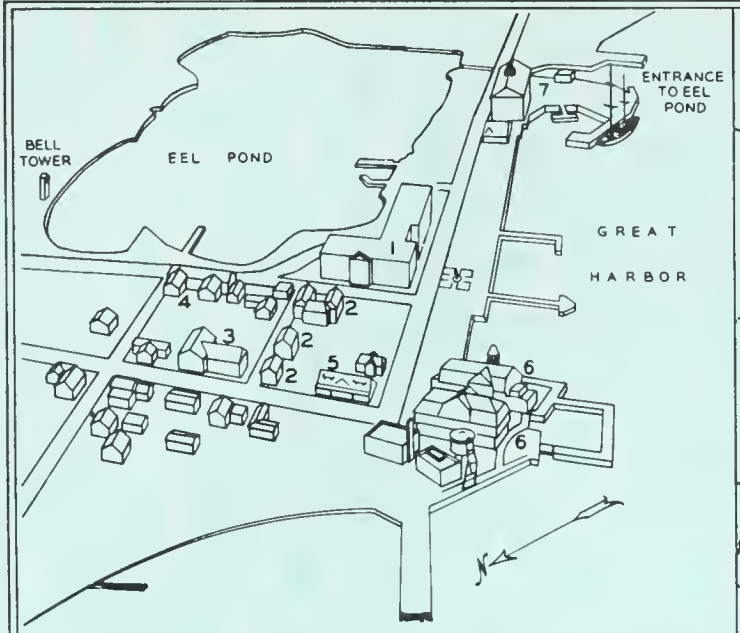


LOCATION PLAT

MARINE BIOLOGICAL LABORATORY

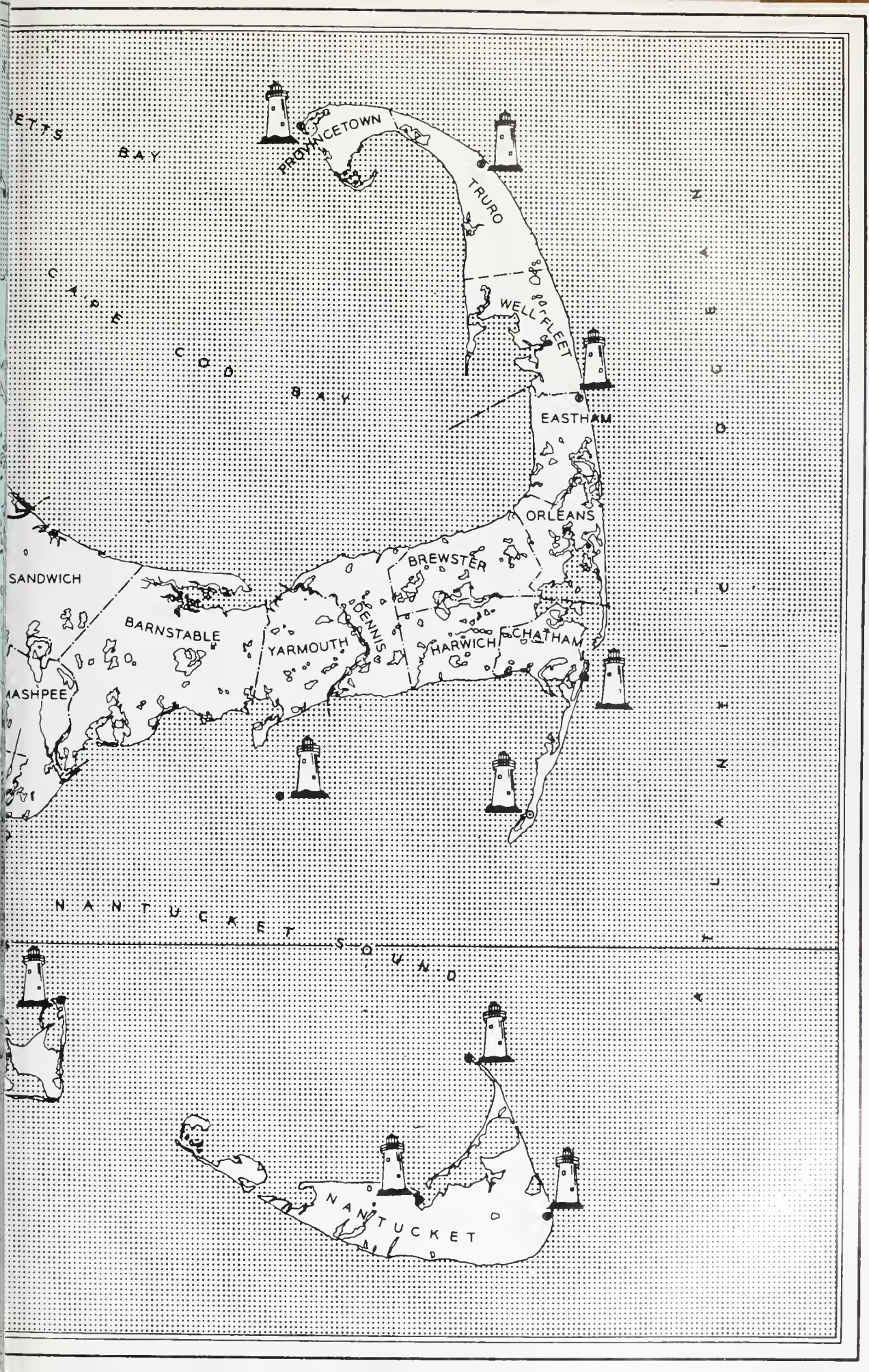
1. MAIN LABORATORY
2. OLD LABORATORIES
3. APARTMENT HOUSE
4. DORMITORY
5. MESS HALL

OTHER LABORATORIES

6. U. S. BUREAU OF FISHERIES (BUILDINGS AND WHARVES)
7. WOOD'S HOLE OCEANOGRAPHIC INSTITUTION (BUILDINGS, WHARVES AND ATLANTIS).

PEMBROKE
HANSON
DUXBURY
HALIFAX
KINGSTON
PLYMPTON
MIDDLEBOROUGH
CARVER
PLYM
ROCHESTER
WAREHAM
ACUSHNET
MARION
MATTAPOISETT
FAIR HAVEN
NEW BEDFORD
FAL
WOOD'S HOLE
BUZZARDS BAY
PENIKESE ISLAND
ELIZABETH ISLANDS
GOSNOLD
TISBURY
WEST TISBURY
MARTHAS VINEYARD
ISLAND
CHILMARK
GAY HEAD
NO MANS LAND

CAPE COD AND ADJACENT ISLANDS


ETTS
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TRURO
WELLFLEET
EASTHAM
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C O D
B A Y
ORLEANS
BREWSTER
SANDWICH
BARNSTABLE
YARMOUTH
DENNIS
HARWICH
CHATHAM
MASHPEE
N A N T U C K E T
S O U N D
NANTUCKET
N A N T U C K E T

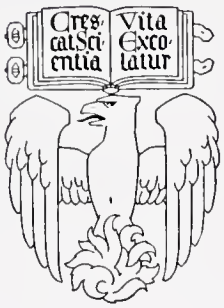
Courtesy of Howard M. Wood, New Bedford, Massachusetts

AERIAL VIEW OF WOODS HOLE FROM GREAT HARBOR, LOOKING TOWARD THE NORTHEAST

The inclosed small body of water is the Eel Pond. For identification of buildings see the plan on page 64 and close-up aerial view on page 69.

THE WOODS HOLE MARINE BIOLOGICAL LABORATORY

FRANK R. LILLIE



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PREFACE

BEFORE all of those concerned with the early development of the Marine Biological Laboratory are gone, as so many already are, and it becomes too late to recapture the early enthusiasm that went into its making, the following history and picture has been prepared. The institution is unique in its organization and government and has won an assured place as one of the strongest influences in the development of biology in America during a period in which our country rose to pre-eminence in this broad field of research. We associate this influence with the Laboratory's form of organization, which had two outstanding features from the beginning first, government of the institution by professional biologists (not only administratively but also as trustees), which secured professional co-operation from the whole country; and, second, the national scope of the Laboratory's operation and its freedom from all restrictions of local institutional control, which secured widespread co-operation from universities, colleges, and research establishments.

These are unique features of the Marine Biological Laboratory. Although not restricted in scope within the field of biology, it shares with many other institutions the task of study of the life of the ocean. At Woods Hole itself the United States Bureau of Fisheries has its first established laboratory, erected in 1885, three years before the Marine Biological Laboratory was born; and the Woods Hole Oceanographic Institution, founded in 1929—in some sense an offspring of the Marine Biological Laboratory—has there its headquarters to paths in the sea and in the great waters. These companions study the ocean and its abounding life from different viewpoints and by different methods. The story that we present will take account also of the interrelations of these three institutions in one Cape Cod village, which is, through them, connected both historically and currently with the science of all the world.

I am indebted for much aid in the preparation of this history—above all, to the constant and abiding friend of the Marine Biological Laboratory, Professor E. G. Conklin, of Princeton University, with whom joint authorship was originally intended. Dr. Conklin's many responsibilities during the period of preparation prevented this; but he did write Chapter I and the section on the United States Bureau of Fisheries in Chapter II, as well as the greater part of Chapter VIII and one of the personality sketches in Chapter VII, all of which sections are duly acknowledged *in situ*. He was, in addition, a constant source of information and encouragement.

Many other members of the Laboratory have also assisted in various ways, especially in the matter of access to original records. The veteran psychologist and editor of *Science*, J. McKeen Cattell, has permitted me to make excerpts from that journal and has furnished unpublished reminiscences of Woods Hole, from which excerpts are reproduced at the end of Chapter VIII. The President of the Rockefeller Foundation has given his unqualified permission to publish the resolutions of the Executive Committee of the Foundation to be found in Chapter IX (p. 183). The executive officer of the Carnegie Institution has furnished a transcription of records from the minutes of meetings of the Executive Committee of the Institution concerning their dealings with the Marine Biological Laboratory between 1902 and 1906, with permission to make use of them, which has been done in Chapter III. The office of Mr. John D. Rockefeller, Jr., gave kind permission to include Mr. Rockefeller's letter to Mr. Charles R. Crane (Chap. IV, pp. 74, 75).

I am indebted to Henry B. Bigelow, president of the Woods Hole Oceanographic Institution, and to C. O'D. Iselin, its director, for reading, and to some extent editing, the final chapter dealing with that institution. Mrs. Alfred G. Mayor has also been so kind as to give me some personal recollections of the inception of the Annisquam Laboratory, founded by her father, Alpheus Hyatt.

Finally, I must acknowledge the aid of my secretary, Mrs. Shirley Davidson Hobson, who shared in the inception and progress of the book and whose work on the various quoted sources, on the appendixes, and on the index has been indispensable.

Two systems of references are used in the text: (1) citations to the bibliographies, with chapter numbers given in Roman numerals and serial numbers in Arabic (e.g., I, 4); (2) to appendixes at the end of the book, with chapter number given in Roman numerals, followed

by the letter "A," and with serial numbers in Arabic numerals (e.g., III, A, 14).

The book was begun when the prospect of a world war cast its shadow upon us and all mankind. During the progress of the book the war broke out, and the immediate effects mark a natural termination of the account. We can only hope that, as we sincerely believe, a new birth of freedom after the war will carry the Woods Hole scientific institutions to still higher levels of usefulness.

FRANK R. LILLIE

CHICAGO, ILLINOIS
April 1944

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CHAPTER I

The Geography and Early History of Woods Hole

By E. G. CONKLIN

THERE are many marine laboratories in the world, but there is only one Woods Hole. It is situated on the southwestern extremity of Cape Cod, which, like a giant arm, 87 miles long, extends from the southeastern coast of Massachusetts into the Atlantic Ocean, the point of the shoulder of this arm being at Woods Hole, the elbow at Chatham, and the fingertip at Provincetown. Inclosed within this area on its northern and western side is Cape Cod Bay; on its southern side are Nantucket Sound and Vineyard Sound, from 4 to 20 miles wide, beyond which are the islands of Nantucket and Martha's Vineyard. On the western side of the shoulder of the Cape is Buzzards Bay, bounded on the north and west by the mainland of Massachusetts and on the south by the Elizabeth Islands, which separate the Bay from Vineyard Sound. At the northeastern angle of Buzzards Bay, the Cape Cod Canal cuts across the base of the Cape into Cape Cod Bay (see endsheet map).

The Cape is in part covered by a terminal moraine,[1] deposits of some ancient glacier, to which have been added the sands thrown up by ocean currents, waves, and winds—all resting upon preglacial sedimentary deposits still exposed in various places, as at Gay Head on Martha's Vineyard (I, 3). The morainal part of the Cape contains many glacial boulders, brought down from the mountains to the north, together with gravels, sands, and clay; and there are many rocky points and sandy coves in the vicinity of Woods Hole and along the Bay shores; while the eastern portion of the Cape is almost entirely sand, with the exception of a glacial deposit in the township of

[1] The so-called "Falmouth Moraine," which on the Cape itself extends from Woods Hole along the west shore, bordering on Buzzards Bay; thence along the line of the Cape Cod Canal and the north shore of the Cape, bordering on Cape Cod Bay, to Dennis and Brewster; thence across the Cape in the township of Orleans, where it terminates at the open ocean (I, 4).

Orleans containing boulders similar to those in the vicinity of Woods Hole; sand dunes with their interesting vegetation are found in certain coastal areas, especially in the eastern part of the Cape and its northern extension to Provincetown.

The land surface over the whole Cape is covered with low hills and deep holes, which were left when the glacier dumped its load or winds piled up the sands. From many of these depressions there is no drainage outlet, with the result that there are many fresh-water ponds and lakes, some of which are used as reservoirs of excellent water for the towns and villages; others are noted for their fresh-water fishes and other living forms of piscatorial and general biological significance. The land was originally densely forested with white and red oak, white pine, cedar, various maples, and many other species; and, despite many forest fires and clearings made by man, much of the western portion of the Cape is still covered with trees. Other portions are densely covered with scrub oak, huckleberries, blueberries, beach plums, and other shrubs, while in some places there are cedar swamps and cranberry bogs.

While the land and fresh waters are thus of much biological interest, the great variety of rocky, sandy, or muddy shores along the coast and the sounds, harbors, lagoons, holes, and gutters of sea water furnish a greatly diversified environment for marine life. Although the Gulf Stream is about 150 miles off the coast, many floating animals and plants from southern waters are brought in by the prevailing winds. Indeed, the marine fauna and flora of the southern side of the Cape are largely southern in character, while those of the northern side include more of the northern forms, the waters of Cape Cod Bay being generally about ten degrees colder than those of Buzzards Bay and Vineyard Sound. Woods Hole is thus about midway between the northern and southern marine faunas and floras, and the biological advantages of such a situation are evident.

The village of Woods Hole has a resident population of about five hundred and a summer population of about three times that number, made up of biologists and their families and other summer residents. It is 4 miles from the town of Falmouth, which is the seat of the government of the township and its chief business center. Woods Hole is connected with the outer world by excellent automobile roads; and it is the terminus of the Woods Hole branch of the New York, New Haven and Hartford Railroad, which makes connections here with the steamboats of the New Bedford, Martha's Vineyard, and

Nantucket lines. It is the only steamboat port on Cape Cod except Provincetown. Consequently, it has excellent connections with surrounding territory and centers of population, although removed from the noise and confusion of such centers, being about 72 miles southeast of Boston and 260 miles northeast of New York.

The geographical setting; the remoteness from large centers of population, which insures freedom from pollution and maintenance of purity of the waters; the variety of shore conditions and animal habitats; and ready access to the open ocean—these explain why successively the United States Bureau of Fisheries (1885), the Marine Biological Laboratory (1888), and the Woods Hole Oceanographic Institution (1930) selected Woods Hole as the site for their scientific laboratories (endsheet map and frontispiece). It is certainly the most strategic center for marine biological and for oceanographic work on the Atlantic Coast. The main theme of this book is the Marine Biological Laboratory, but the mutual benefits of association of the three institutions are so great that the others cannot be neglected.

After the manner of Washington Irving's *Knickerbocker's History of New York* or of Wells's *Outline of History*, the story of Woods Hole should begin with the glacier that fashioned our hills and holes and islands. Following the glacial epoch should come the peopling of this region with plants, animals, and Indians. Unfortunately, there are no living witnesses or written records of those prehistoric times, nor of the much later period when it is claimed that the Norsemen visited this coast and named it "Vineland the Good." Our only relic of the Norsemen is found in the former spelling of Woods "Holl," which was supposed to be Norse for "hill"; and, accordingly, the original spelling "Hole" was formally changed to "Holl" in 1877. A stone on the former small, arched bridge over the inlet to the Eel Pond recorded this change until that bridge was removed and the first drawbridge constructed, about 1910. That stone now stands between the Community Hall and the Fire Engine Station as a monument to this supposedly Norse discovery. The official name of this place was "Wood's Holl" from 1877 to 1896, when the United States Post Office changed the name back to "Hole," much to the disgust of many, including the first director of the Marine Biological Laboratory, Professor C. O. Whitman, who had named certain local species "hollensis."

The stone tower on the hill between Little Harbor and Nobska, with a fine outlook on its top (p. 4), is now built into Mr. Newcomb Carlton's house; it was not a relic of Norse occupation, as many

persons supposed, but a water tower built by Mr. Glidden about 1870, and for obvious amatory reasons it was long known as the "Rustic Spoon Holder."

Before the coming of Europeans, Indians were fairly numerous on the Cape, especially along the Bay shore, as is proved by shell heaps, arrowheads, graveyards, and the Indian names of places. Some

GLIDDEN TOWER WITH NOBSKA LIGHTHOUSE IN THE DISTANCE

of their descendants are still left at Mashpee and at Gay Head and Indian Hill on the Vineyard.

The earliest record of English settlement on this continent is that of Captain Bartholomew Gosnold in May, 1602, five years before the settlement of Jamestown and eighteen years before the landing of the Pilgrims at Provincetown and Plymouth. Gosnold coasted along "Cape Cod" and "Martha's Vineyard," which he so named. It seems probable from his account that he anchored at Vineyard Haven and later (May 31, 1602) landed at what is now Woods Hole. He changed the name of the island called "Cuttyhunk" by the Indians to "Eliza-

beth," in honor of his queen; and to this day the chain of islands between Buzzards Bay and Vineyard Sound is called the "Elizabeth Islands"; the township is known as "Gosnold." A monument to Gosnold was placed on Cuttyhunk near the place where he had built a fortified house in 1602. He also made a temporary settlement near what is now Falmouth, known as "Succanessett"; and the present seal of the town of Falmouth bears the inscription: "Succanessett 1602."

The Elizabeth Islands bear Indian names which are hard to remember; consequently, they have been embalmed in rhyme, listing them in order, from west to east, as follows:

Cuttyhunk and Penikese,
Nashawena, Pasque(nese)[2]
Great Naushon and Nonamesset,
Uncatena and Weepeckets.

Without respect to geographical order, they are sometimes rhymed as follows:

Naushon, Nashawena,
Nonamesset, Uncatena,
Weepeckets, Pasque(nese)[2]
Cuttyhunk and Penikese.

The name "hole" was probably given by early settlers to inlets, such as Vineyard Haven, formerly called "Holmes' Hole," or to water passages between lands such as "Wood's Hole" between the mainland and Nonamesset, "Robinson's Hole" between Naushon and Pasque, and "Quick's Hole" between Pasque and Nashawena. The United States Post Office authorities on geographical names were therefore right in restoring the original spelling of "Hole" and even in eliminating the apostrophe in "Wood's," though this conceals the Norse tradition, confuses the significance of certain specific names, and formerly offended the eyes and ears of fastidious persons. At present the name "Woods Hole" has become so widely known and so highly honored that residents and visitors are proud of it.

In 1606 Champlain sailed along this coast as far south as the Hole which the historian Bourne (I, 1) says he mistook for a river and named "Champlain." Although other locations have since been named in honor of Champlain, the easternmost hole between Buzzards Bay and Vineyard Sound is said to be the only spot to which he himself attached his name. Bourne proposed that this hole should be

[2] Poetic license.

called "Champlain Strait"; but the Yankee love of plain and homely names still prevails in such designations as the "Hole," "Buzzards Bay," and "Crow Hill," although "Long Neck" was changed to "Penzance" when it became a fashionable place of residence.

In 1907, after the Jamestown Tercentenary, the residents of this region bethought themselves of the earlier discovery and settlement here in 1602 and held a Gosnold Tercentenary five years late. At this celebration the Marine Biological Laboratory schooner "Vigilant," rechristened and refitted for the occasion as Gosnold's ship "Concord," sailed into Great Harbor and landed "Captain Gosnold" (Mr. Purdum) and his officers near the present Yacht Club. Friendly "Indians" received them with presents of sassafras, and the "Sachem" smoked the pipe of peace with "Gosnold." They then proceeded to Falmouth and dedicated the Memorial Boulder just beyond the railroad crossing at the entrance to the village. The landing place and other historic sites along this route have since been marked by bronze tablets. One of them, now belonging to the Marine Biological Laboratory, reads:

CANDLE HOUSE

1836

This building was used for
the manufacture of spermaceti candles
and as a store and supply house
for the outfitting of whaling vessels.
The following vessels were built
on Bar Neck Wharf
Ship Uncas 1828
Ship Bartholomew Gosnold 1832
Ship Commodore Morris 1841
Bark Elijah Swift
This tablet was placed here by
the Town of Falmouth
1930

The settlement at Succanessett was soon abandoned, and the present town of Falmouth was first permanently settled in 1660 by people from West Barnstable. The land of Woods Hole was first apportioned among its thirteen settlers on July 23, 1677. Quisset was settled in 1691. The earliest settlements at Woods Hole were around Little Harbor. The oldest house stood on the southeast side of the harbor and is now built into the Sargent house. On that side of the harbor were an old grist mill, motored by an old-fashioned windmill, and a salt mill

and salt pans, to which sea water was pumped up by wind power and evaporated by the sun's heat for sea salt.

There were many stirring events hereabouts during the Revolutionary War. British war vessels were often in Vineyard Sound, and especially at Tarpaulin Cove. A British fleet of ten sails visited Woods Hole on April 1, 1779; marines killed cattle and attempted to burn the town but were driven off. They returned on April 3 and cannonaded Falmouth, but were prevented from landing by four companies of militia—a total of about two hundred men. At one time, a schooner laden with corn from Connecticut was seized by a British privateer as she was entering the Sound and was taken to Tarpaulin Cove. Colonel Dimmick, who commanded the militia of the town, was notified of this, and with twenty men in three whaleboats he pulled to the Cove, seized the schooner, and sailed away with her, finally bringing her into Woods Hole. In 1812 the British frigate "Nimrod" bombarded Falmouth and destroyed many buildings. She landed marines in Little Harbor and destroyed property there (I, 2).

At a later date,[3] about 1845, an old red schoolhouse stood at the head of Little Harbor, about where the railroad now runs. Back of this and across the main road were the Purdum house, the Ferguson house, and the Fay house, all now standing; and on the west side of the harbor was Joe Parker's Tavern, which has long since disappeared and which was a favorite resort of Daniel Webster when he was on fishing trips to Woods Hole. Joe Parker operated a ferry to and from Martha's Vineyard, which was the only regular connection between the island and the mainland.

Still later, about 1860, two hotels, or taverns, were built on the west side of Little Harbor. One of these, the Dexter House, accommodated some of the early workers at the Laboratory; it was torn down in 1927. The other, the Webster House, which stood between the Dexter House and the present railroad station, was destroyed by fire much earlier.

Between 1815 and 1860 Woods Hole was a center of the whaling industry. Nine whaling ships made this their port; and the Bar Neck Wharf, where the Penzance Garage and the Woods Hole Oceanographic Institution now stand (Chap. IV, p. 64), was a busy place, out-

[3] For the following notes on the early history of Woods Hole, I am indebted to our late fellow-townsman, Mr. Frank L. Gifford, who has painted many very interesting pictures from old sketches and descriptions and, at a later period, from photographs and his own recollections of the village.—E. G. Conklin.

fitting these whalers and receiving their cargoes of oil and whalebone on their return. The old stone building, or Candle House (p. 66), was built in 1836; here whale oil was stored and spermaceti candles made, and certain evidences of the building's uses are still seen in the old flues, hearths, and cranes. The old shingled building which adjoined it on the east, and which was torn down in 1924, was a bakeshop, where hardtack or sea biscuits for the long voyages around Cape Horn were baked; this building was for many years the carpenter shop of the Marine Biological Laboratory. Other buildings, now gone, were a ropewalk where rope was made, a cooper-shop for making hogsheads to hold whale oil, a blacksmith shop, etc. With the discovery of petroleum in western Pennsylvania in 1858, the whaling industry rapidly declined and died, and these old buildings were for a long time practically unused until the Marine Biological Laboratory acquired them and converted them to a new kind of whaling industry.

About 1850 Mr. Joseph S. Fay, cruising along this coast, sailed into Little Harbor, went ashore, and bought a farm, to which he later added many barren and rocky acres. The whole region at this time was practically treeless, although originally covered by forests which had been cleared off for farming and grazing. Mr. Fay set to work importing and planting many trees over much of his estate, leaving the highest part of the present golf links as meadow, which was known as "Mowing Hill." From this reforestation there developed the well-known "Fay Woods" with their beautiful woods roads, which were open to all visitors and were the joy of early workers at the Laboratory. Alas! these woods are now sadly depleted by the gypsy moth, the golf course, and the inroads of civilization. Mr. Fay's interest in trees and in reforestation explains a clause forbidding the cutting-down of trees, except where necessary, in the deeds of lots in the "Gansett property" (p. 67).

Another famous estate in the vicinity of Woods Hole is Naushon and the adjoining islands, formerly owned by Mr. John M. Forbes and at present by his heirs. This was described by Oliver Wendell Holmes in the *Autocrat of the Breakfast Table* as "the finest private domain in America"; and, as he watched, from the porch of the Forbes house on Naushon, the schooners tacking back and forth in the Sound, Holmes conceived and later wrote his beautiful poem "Light and Shade."

Following whaling days, the only commercial venture of note at Woods Hole was the Pacific Guano Works, of unsavory odor and

memory, for its failure about 1880 brought financial disaster to many residents of Woods Hole. It was located near what is now the entrance to Penzance. Here stood the old red factory buildings and tenement houses; and here the odor of guano lingered until the plant was demolished and the present Penzance property was established, more than twenty years later. It is interesting to note that Penzance, nee Long Neck, was formerly an island, especially at high tide. When the guano company located there, they built the stone wall along the side of the road at the entrance to Penzance as a breakwater and filled in land to make a road which could be used at all stages of the tide. The present Breakwater Hotel owes its name to this wall, as it owes its original construction to a row of old tenement houses for employees of the guano works. In the early days of the Marine Biological Laboratory the abandoned wharves and shed of the guano company were the favorite bathing place for the men of the Laboratory. Here we swam without even a one-piece bathing suit, and the long-distance diving from the high pier was one of the major sports of that time. When the place became too conspicuous for such naked sport, the Laboratory men resorted to the rocky shore between what is now Gardiner's hill and Lillie's pier, and which was well named "Barnacle Beach." This brings the story of Woods Hole down to, and a little beyond, the time when it began to acquire biological significance, and that must form the subject matter of another chapter.

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CHAPTER II

The Origin of Marine Laboratories in Europe and America

I. Introduction

HAVING considered the local setting of our institution, we shall now take up its scientific origins and the interesting history of its foundation. This is part of the story of the organization of study of the life of the ocean. But organization was preceded by much experience with marine life which is lost in the antiquity of early human settlements by the sea, of the utilization of the sea's resources, and of the beginnings of navigation. The sea was also then a subject of wonder and amazement, not only because of its beauty and power but also because of its strange denizens, real and fabled, as portrayed for us in the Bible and in the poems of Homer, in ages of scientific innocence.

Aristotle (384–322 B.C.), born in Stagira, a Greek colonial town on the margin of the Aegean Sea, was the first systematic and philosophical student of marine zoölogy. We may deduce from his writings that in his youth he was a frequent companion of fishermen and that he assimilated their lore; also, that at various periods in his life he systematically collected sea animals and studied their anatomy, habits, modes of reproduction, and compared and classified them, together with all other animals known to him. His *Historia Animalium* reveals an amazing richness and acuteness of observation on various marine sponges, coelenterates, echinoderms, mollusks, crustaceans, ascidians, fishes, both bony and cartilaginous, and cetaceans. This flowering of marine zoölogy was not surpassed for upward of two thousand years.

The purpose of this reference to ancient times is only to indicate the antiquity of interest in the life of the ocean and not to introduce a historical account of the development of knowledge of marine life. Suffice it to say that with the development of biology from the seventeenth to the nineteenth centuries there gradually developed consciousness of the need of organization for effective exploration of the

scientific and economic riches of marine life. This could be effected only from permanent bases.

The importance of marine life for the study of general biology depends on several circumstances. The oceans have been the most permanent features of the earth's surface throughout geological history; the continents have been mobile features—at certain geological epochs sunk in large areas beneath the surface and receiving deposits of marine sediments, at other epochs slowly rising. But there is no evidence that the ocean depths have changed; only the margins have changed with the subsidence and elevation of the land masses. The oceans have therefore furnished the most constant environment for the evolution of living things since their origin; and there are convincing reasons for regarding the oceans as the first environment, in point of time, for their evolution. For this and related reasons, the oceans, which now constitute about two-thirds of the earth's surface, contain forms of animal life never found on continents or in their fresh waters. Many of these are the most ancient forms, in a geological sense, in the world. The entire phylum of Echinodermata is exclusively marine; so, with minor exceptions, are the sponges and coelenterates. Among the mollusks the cephalopods (squids and octopi) are exclusively marine; and among the vertebrates the Selachia (sharks, rays, etc.) are practically exclusively marine. Apart from such great and zoölogically important groups, the oceans contain myriads of forms representing every phylum of the animal kingdom specially adapted to various oceanic environments, such as those of the almost infinitely diversified shore or littoral regions, of the pelagic (lighted) and the abyssal (unlighted) zones of the free oceans to the floor at great depths, and of great oceanic territories such as those of the Gulf Stream and other ocean currents and of the arctic and antarctic cold and of the tropics (II, 1 and 12).

It was such considerations as these that led, with the rapid development of zoölogy and botany in the early years of the nineteenth century, to the establishment of the first marine stations as bases for intensive and comprehensive study of marine life. The development of fisheries and other economic considerations also played a leading role.

When the development of zoölogy began to require the use of experimental methods in the latter part of the nineteenth century, it was gradually found that marine material offered exceptional advantages for investigation of fundamental problems. Thus, the beginnings and much of the development of general physiology in America

are due to the work on marine material at Woods Hole. Sea water is an ideal medium for protoplasm. The specific gravity of both is about the same; the internal fluids of marine organisms contain the same major inorganic salts as sea water in about the same proportions and usually of the same concentrations. The eggs of many marine animals, such as sea urchins, starfish, and various worms and bivalve mollusks, for instance, are deposited at random and in enormous numbers in the sea water, and do not require special protective devices such as are usual in other environments. They may readily be cultivated *in vitro*, and they offer endless opportunity for embryological and physiological experiments. This is but one example of the special utility of marine material for general biology. Marine laboratories will have unique functions to perform as long as scientific biology endures.

It is a little difficult for us, in this period of technology and specialization, to realize the freshness of enthusiasm that went into the development of biology as an intellectual discipline in the seventeenth, eighteenth, and most of the nineteenth centuries. The constant discoveries of new animals and plants and of the principles of their reproduction, the essays in classification, the controversies concerning the interpretation of embryonic development, whether by preformation or epigenesis, the growth and establishment of the cell theory, the debates over the role of chemistry and physics in vital processes and concerning vitalism versus mechanism, the triumph of the theory of organic evolution over that of special creation and of biogenesis over abiogenesis—all profoundly affected the intellectual milieu and the outlook on society, philosophy, and religion. Those concerned with the direction of this amazing advancement, whether as investigators or as teachers, were affected with a truly missionary zeal for their cause. Without implying that biology has lost in intellectual interest what it has gained in economic importance, there is, nevertheless, a change of spirit. The field has expanded so enormously, specialization has proceeded so far, and means for research are relatively so abundant that there is not the same sense of personal responsibility as in the days when men had to struggle for opportunity instead of finding it ready to hand and free.

It is not our purpose to furnish a detailed history of the origin of marine laboratories outside of America. This will be found in the books of C. A. Kofoid (II, 13) and T. Wayland Vaughan (II, 16), which contain adequate references to original sources. The point of departure for the work of the Marine Biological Laboratory may be

found only partially in any such history of European antecedents, for it has followed a very different plan of development into an institute of general biology having the inestimable advantage of possessing facilities for the utilization of marine life.

As Kofoid states, "France enjoys the unique distinction of having had the first marine biological station in the world, founded at Concarneau in 1859" (II, 13), by J. J. Coste, a French naturalist, and later directed by professors associated with the University of Paris—more specifically, with the Collège de France. At about 1863–67 the local scientific society of Arcachon set up an aquarium in connection with its museum and library and offered facilities for marine biological research.

> . . . . in the next dozen years, following in the general wave of advance in biology of that period, led by the untiring efforts of the far-sighted Lacaze-Duthiers, and stimulated in part by the example of Naples, stations followed in rapid succession at Roscoff (1872), Wimereux (1873), Luc-sur-Mer (1874), Marseille (1876), by the private stations of Fol and Barrois at Nice, by the French Station at Villefranche (1880), Banyuls (1883), and Boulogne (1884) [Kofoid, II, 13].

The foregoing stations were, on the whole, local in their spheres of influence. The Zoölogical Station of Naples (1872) was the first great international marine biological observatory in Europe and for many years by far the most influential. Its founder, Anton Dohrn, acknowledged (II, 5) the influence of Carl Vogt, who had endeavored from 1844 to 1870, among many other activities, to organize a permanent zoölogical station on some seashore (II, 17 and 18). Vogt's attempts had failed, for various reasons. With Dohrn, however, the idea became an obsession, to which he willingly devoted his entire life and much of his personal fortune. He pointed out (II, 5) that astronomy and meteorology possess special laboratories and observatories which would carry on these sciences "even if all the universities were extinct at once." Dohrn continued:

> Amongst the number of the sciences, perhaps the most neglected in the way of co-operation is Biology, that science which occupies at present such an eminent place in the public interest, and yet the most neglected, in so far as no other science will present the necessity of co-operation and organization so much as biology [II, 5].

As a practical beginning, Dohrn interested the municipality of Naples in the project of building a great public aquarium in the Villa Nazionale on the bay. This accomplished, he had "the pleasure of finding almost everybody in England and Germany quite ready to

assist as much as possible." The beautiful original building was erected by Dohrn himself under a contract that vested ownership of the building in the Dohrn family for a period of ninety years, the ownership then to revert to the city of Naples. The support for the station was derived from the fees of visitors to the aquarium and by subscriptions for "tables," i.e., working places, for naturalists from several of the German states, from Italy, Hungary, Austria, Russia, Holland, Belgium, Switzerland, and from universities and societies of several countries, including the United States (II, 10). Two other buildings were erected by subscriptions from the governments and citizens of Germany and Italy; these were supported by annual subventions of about $5,000 from the German and $1,000 from the Italian government for many years. In the height of its activity, before the first World War, Naples was the chief international center for zoölogical research.

The Naples station, though located in Italy, was the work of German scientific and organizing genius. Following closely on the heels of the Franco-Prussian War of 1870, it enjoyed the benefits of the newly acquired international prestige of Germany. The idea of international co-operation in its program was due, however, entirely to Dohrn and was a conception that could hardly survive the first World War and the later rampant German glorification of nationalism. From the Naples station the Marine Biological Laboratory derived, in part, its system of university-supported tables and this much, at least, of its principle of co-operation.

In other respects, also, this station exerted great influence on zoölogy in America through the numerous American zoölogists who worked there and came into contact and developed cordial relations with many of the German and other European scientific leaders. Science was free, at that time, throughout Europe; and the bonds of sympathy in the spirit of research were strong. The Americans brought home fructifying ideals of scientific research. Among the American biologists who worked there up to about 1912 were a number of trustees and members of the Marine Biological Laboratory. The first director of the Laboratory, C. O. Whitman, worked there for six months during the years 1881–82 and developed a strong friendship with Dohrn, who later encouraged Whitman in the organization of the Marine Biological Laboratory (III, 21) and made him a memorable visit at Woods Hole in the summer of 1897. So keenly was the admiration for the

Naples station felt in America that strong influences were at work around 1902 to remodel the Marine Biological Laboratory in the image of Naples (Chap. III, p. 57, and III, A, 14).

II. Louis Agassiz and Penikese

The first American seaside laboratory was founded in 1873 by Louis Agassiz on the remote island of Penikese in Buzzards Bay, near the western end of the chain of the Elizabeth Islands off the shoulder of Cape Cod. The site was determined accidentally; but the event, one of the most striking episodes in the life of its illustrious founder, was long prepared for by his studies and teaching.

Agassiz, before coming to America (in October, 1846, at the age of thirty-nine) and in spite of his previous studies on recent and fossil echinoderms, had never observed marine animals in their natural habitats (II, 22, p. 455). Set on the New England shore, he immediately became absorbed in their study, and he found them as stimulating as were his Swiss glaciers previously. In 1847 he established himself in a house which was close to the harbor in East Boston and conveniently situated for collecting sea animals. Here he was joined by Count Pourtales, E. Desor, a draftsman, and a lithographic artist. The house served both as dwelling and as laboratory. In the summer of 1847 he made numerous excursions in the harbor and bay of Boston on the United States Coast Survey steamer "Bibb" (captain: Charles Henry Davis) to study the life of its waters. Among the first-fruits of this new enthusiasm, which accompanied him throughout life, were twelve lectures given before the Lowell Institute of Boston in December, 1848, and January, 1849, on "Comparative Embryology," in which the development of marine animals played a large part. In 1848 he moved to Cambridge to assume the duties of his first appointment in Harvard University as professor of natural history in the newly established Lawrence Scientific School. In 1855 he occupied a small, private laboratory on the seashore adjacent to his summer home in Nahant, which was easily accessible from Cambridge. Here he and his assistants worked regularly in summers and often also at other seasons, especially on the life-histories of medusae, though apparently nothing marine escaped his interest and attention, either there or in extended voyages later.

Agassiz was an inspired teacher; and, finding in America a public yearning to be taught, he devoted himself in various ways to their

education in science so constantly with heart and soul that, as his biographer, Marcou, remarked: "It is fortunate for the progress of science, to which Agassiz contributed so largely during his twenty years of work in Europe, that he did not begin his scientific life in America, for his extraordinary ability as a teacher would have absorbed all his time" (II, 32).

The intense interest of Agassiz in marine life and in education was centered, in the last year of his life, upon the establishment and operation of the Anderson School of Natural History at Penikese. Agassiz had been away for ten months—from December, 1871, to October, 1872—on a scientific expedition around South America and to California (II, 22). When he returned to Cambridge, he found that an idea previously propounded by himself and discussed with associates at Harvard had reached a stage of development ripe for practical consideration. This was the establishment of a summer school of natural history somewhere on the Massachusetts coast for teachers and professors from schools and colleges. Work accumulated from the long expedition just ended and numerous other duties and calls on his time did not deter him from this task; and, in spite of ill health, he threw himself ardently into it with the aid of his associates.

In December, 1872, a circular was issued by Agassiz from the Museum of Comparative Zoölogy, entitled a *Programme of a Course of Instruction in Natural History, to be delivered by the Seaside, in Nantucket, during the Summer Months, chiefly designed for Teachers who propose to introduce the Study into their Schools, and for Students preparing to become Teachers* (II, A, 1). The program contained no less than twenty-one subjects, a distinguished list of lecturers, including Agassiz himself, and promise of co-operation from the superintendent of the United States Coast Survey and the United States Commissioner of Fisheries. This roused considerable public interest; and in March, 1873, Agassiz presented his plan to the Massachusetts State Legislature as an educational branch of the Museum which, on that account, deserved their interest and support.

His remarks, widely circulated in the daily press, came to the attention of Mr. John Anderson, a merchant of New York, who thereupon sent a friend, Mr. W. Girod, with a letter conveying to Agassiz a formal offer of the island of Penikese, its buildings and improvements, "to be perpetually used as a location for your proposed naturalists' school" (II, A, 2). Agassiz promptly accepted the gift (II, A, 3), although the

relative inaccessibility of the island was felt by some, including his son, Alexander, to render it a precarious site for a permanent institution. In accepting the island, Agassiz emphasized the absence of living accommodations, which would need to be specially provided; and Mr. Anderson promptly replied with a gift of $50,000, "to be invested as the nucleus of a permanent endowment fund" (II, A, 4); but he soon agreed to its use for buildings, equipment, and the running expenses of 1873. All but $3,000 of the amount was actually so expended in 1873 (II, 20).

Agassiz was inflexible in his determination that the laboratory should be opened that year; but to provide housing and boarding accommodations for the fifty students expected and for the staff and some members of families, between April 22, the date of formal presentation of the property, and July 8, the date set for opening, required haste. His commitment by the Nantucket circular was no doubt one impelling reason for proceeding without delay; and he probably felt that his own time was running short, though he could hardly have had a premonition of his death before the year's end. The most important accommodations were ready on the date set; and during the summer, with study going on, the remainder of the building and equipment was completed. The main building consisted of two separate, parallel units of two stories, each 120 × 24 feet, united in the center by a lecture hall 34 feet long, surmounted by a cupola. The second stories of the two units were dormitories containing fifty-eight small bedrooms. The lower floors were undivided laboratories with individual work tables, each provided with a separate aquarium. In addition, there was the old residence and two smaller buildings. Truly a bountiful provision for what was to prove, after all, only a two-year experiment!

The Penikese adventure was a classic event in the history of American science and education. It was felt to be a dramatic occasion at the time and received much notice in the press, both in America and Europe (II, 26, 28, 34, 35, 36, 37). It was, indeed, great for the inspiration of its leadership and the devotion of its following; one senses the freshness of dawn in it. To celebrate the event, Whittier wrote a poem, "The Prayer of Agassiz" (II, A, 7). Significance grew with the perspective of time, and glowing estimates came years later from pens of participants (II, 25, 30, 31, 33, 38).

According to David Starr Jordan (II, 31), Agassiz received hundreds of applications for admission, from among which he chose thirty-

THE ANDERSON SCHCOL OF NATURAL HISTORY AT PENIKESE IN 1874

five men and fifteen women with utmost care. As an illustration of this care, the following letter may suffice:

CAMBRIDGE, MASS.
May 18, 1873

DEAR MADAM:

Applications for admission to the Anderson School of Natural History are pouring in at an embarrassing rate. Among the latest applications there are some which seem to me to have higher claims than preceding ones. I therefore appeal to all who have already been admitted to state again how important it may be for themselves, or for the cause of education in general, that their individual case should be recognized, as fifty persons only can be accommodated in the laboratories of Penikese. To some, admission next year may perhaps be quite as useful as this year. Any failure to answer this request within a fortnight will be considered as a resignation.

Very truly yours,

LOUIS AGASSIZ.

Actually, twenty-six men and seventeen women from six eastern and five midwestern states were in attendance the first session (II, A, 6). Among them were some destined to play important parts in the history of the Marine Biological Laboratory at Woods Hole: C. O. Whitman, then thirty years of age, its first director; C. S. Minot, one of the incorporators and a trustee (1888–97); and W. K. Brooks, a trustee (1893–1908). Agassiz himself lectured nearly every day on such subjects as glaciers, methods of studying natural history, radiates, and general embryology. About twenty others accepted Agassiz's invitation to co-operate in the work of the School; among those who bore most of the work of instruction were Arnold Guyot, Count Pourtales, B. G. Wilder, A. S. Packard, E. S. Morse, Alfred Mayer, Frederick W. Putnam, D. S. Jordan, Edwin Bicknell, and D. Waterhouse Hawkins. The yacht "Sprite" was used for dredging operations during the entire summer, under the direction of Count Pourtales. Instruction in natural-history drawing was given by Paulus Roetter. Everything was free to the chosen band except the board, which was furnished at cost.

A typical day was described, somewhat as follows, by a pupil who remained anonymous (II, 25). The most important lectures were given in the early morning and in the latter part of the day. There was generally a dredging excursion, with eight to ten pupils on board—as many as could be accommodated. On return, Professor Packard would take up the crustaceans, Professor Morse the mollusks, Professor Jordan the algae, and Professor Bicknell microscopical observation. There might also be exercises on physical geography under Guyot, on ornithology under Brewer, on extinct mammals under Hawkins; and

"Mr. Roetter taught us to draw them all." The days, and evenings also, were full. The school opened July 8 and closed August 29.

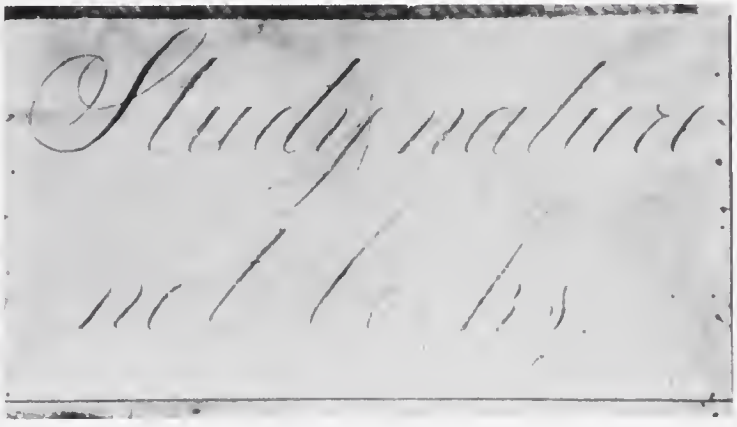
LOUIS AGASSIZ LECTURING AT PENIKESE

Agassiz made his conception of the school clear in his address to the students on the opening day:

Our object is to study nature, and I hope I may lead you in this enterprise so that you may learn to read for yourselves. We should make nature our text-book; whenever

we read books we are removed from the things we could be better acquainted with; instead of the things themselves we appropriate the interpretation of some one else; and, however correctly we may have done this, we invariably return to the study of the things themselves, whenever we wish to make real progress; and I hope to live long enough to make text-books useless and hateful, without even implying a reflection upon the services text-books may have rendered in past times. . . . . From the method of teaching adopted, only a limited number of pupils could be received, and the advantages you enjoy to-day have given you greater facilities for work, better appliances than I had myself, not merely when commencing my career, but when making some of my most important investigations [II, 24].

This was a theme upon which he touched frequently, notably in correspondence with prospective pupils. The walls of the laboratory bore



Courtesy of E. P. Little

MOTTO FROM THE PENIKESE LABORATORY, PRESERVED AT THE MARINE BIOLOGICAL LABORATORY AT WOODS HOLE

the motto "Study Nature Not Books," among other mottoes, some of which are still preserved at the Marine Biological Laboratory.

The operation of the Penikese laboratory was entirely different from that of the European marine laboratories, which were organized for research exclusively. In Agassiz's plan, the primary idea was instruction in direct observation of nature, as against the stereotyped and bookish methods of instruction in natural history then in vogue; but he wished at the same time to establish direct connection with the educational system of the people. The spirit and practice of research were encouraged, however. Agassiz's plan suited the relatively undeveloped state of biology and of scientific education in America in his time and the more democratic spirit of the American people.

Some of its features have been carried over into later-organized marine laboratories.

Agassiz died in December, 1873. The school was operated again in the summer of 1874 under the directorship of Alexander Agassiz, chosen by his father to succeed him. It was now fully equipped with dormitories and laboratories accommodating fifty students, with lecture-room, dining-room, and kitchen and with a separate residence for the teachers. Applications for admission were numerous, including those from many who had been there the year before. The session opened auspiciously; but, shortly after, Alexander Agassiz was obliged, on account of ill health and by order of his doctors, to leave the laboratory in charge of A. S. Packard and F. W. Putnam while he went away to recuperate (II, 23, p. 130). It was a very successful session, from the point of view of the students, but destined, nevertheless, to be the last one.

There was some controversy for several years as to the reasons for closing the school after the second session although applications for admission to a third session in 1875 were in excess of accommodations. The second director stated (II, 20, 21), in response to protests, that the trustees had made every effort to save the school but that neither Mr. Anderson nor the trustees were willing, or able, to meet the expense of continuing to operate it. Applications to legislatures of several states for aid were unavailing. The experiences of the second year, which wound up with a deficit, had confirmed the opinion of the trustees that the site was an impractical one from any standpoint of economy of operation; and a proposal to remove the school to Woods Hole met with no success. Unquestionably, the trustees had the warmest sentiments for Louis Agassiz personally and a genuine desire to perpetuate his last undertaking; but the current of circumstance was too strong, and they ultimately felt compelled, with the authorization of the legislature of Massachusetts, to convey back to Mr. Anderson all right and title to the island, including the buildings which had been erected upon it for the use of the school.

Alexander Agassiz, who followed in his father's footsteps in so many ways—as zoölogist, as authority on echinoderms and coelenterates, and as director of the Museum of Comparative Zoölogy—built a very complete research laboratory on his estate occupying a little peninsula near Newport, Rhode Island. There were accommodations there for about twelve assistants and advanced students, who were made welcome for a period of about twenty years, beginning

in 1877. Although it was planned as a kind of substitute for the Penikese laboratory, the Harvard authorities were indifferent and did not encourage its maintenance; and the establishment of the laboratory of the United States Bureau of Fisheries (1885) and of the Marine Biological Laboratory (1888) at Woods Hole seemed to render this private venture of Alexander Agassiz unnecessary, and so it was closed to students in 1898 (II, 23).

It has sometimes been said that the Marine Biological Laboratory is the direct or lineal descendant of the Penikese laboratory; but this is not to be understood as implying continuity of organization. The Anderson School of Natural History at Penikese left no direct descendant, not even an heir. Its very buildings remained permanently unoccupied and were destroyed by fire in 1891. Its history was glorious but short. What may with justice be said is that many received inspiration there and spread it in American educational institutions, thus contributing to the more rapid development of biological science. Agassiz's vision ahead of his time resulted in a premature birth; and the development of marine laboratories in America, which he had correctly anticipated, had to start again from small beginnings, keeping pace with the progress of biological research, which was slow long after the time of Agassiz but was destined to require and receive at the hands of those who held inspiration from him larger development than he himself had ever imagined.

Certainly his influence survives at Woods Hole even to this day. This was recognized in a celebration of the fiftieth anniversary of the founding of the Penikese laboratory held at the Marine Biological Laboratory on August 13, 1923. A bronze tablet was specially prepared for the occasion; the original was set in a granite boulder on the highest point of Penikese, and a replica in the halls of the Woods Hole Laboratory. It reads:

In Commemoration
of the
Anderson School of Natural History
Established Fifty Years Ago on the
Island of Penikese
by
Jean Louis Rodolphe Agassiz
Born 1807 Died 1873
The Marine Biological Laboratory
the Direct Descendant of the
Penikese School Erects this Tablet
1923

III. The United States Bureau of Fisheries

By E. G. Conklin

The Bureau of Fisheries of the United States Department of Commerce, known prior to 1904 as the "United States Fish Commission," must also be reckoned among the forces that combined in the establishment of the Marine Biological Laboratory. Spencer F. Baird (1823–87), its founder (II, 42, 43, 44, 47, 48), was appointed assistant secretary of the Smithsonian Institution in 1850 under Joseph Henry and, upon the death of the latter in 1878, succeeded him as secretary and served until his own death, in 1887.

Early in his career, Baird, as a zoölogist, became interested in fishes and made extensive collections at various points along the Atlantic Coast. In the summer of 1863 he visited Woods Hole for the first time (II, 42, p. 363). As he continued his collections, he became impressed with the need for protecting the fisheries. Wherever he went on his collecting trips he was met with comments and complaints concerning the rapid decrease in the productivity of the fisheries. Thus, he stated in 1871 in a letter to the Committee on Appropriations of Congress: "The belief is everywhere loudly expressed that unless some remedy be applied—whatever that may be—the time is not far distant when we shall lose, almost entirely, this source of subsistence and support, a calamity which would involve a vast number of evils in its train" (II, 42, p. 420). This representation to Congress resulted in the passage of a joint resolution for the appointment "from among the civil officers or employees of the government, of one person of proved scientific and practical acquaintance with the fishes of the coast, to be Commissioner of Fish and Fisheries, to serve without additional salary." An appropriation of $5,000 was made to defray the expenses of the proposed investigation. In 1872 the study of fish culture was added to the work to be performed by the Commission.

The resolution indicated that Professor Baird should fill this office; and he was accordingly appointed and served, to the end of his life, without salary. This was an additional burden to his executive duties as secretary of the Smithsonian Institution, and one that was destined to occupy a large proportion of his time, as the Bureau expanded and its work became continuously more onerous. Not only did Professor Baird serve without salary, but for many years he personally bore part of the expenses of the Commission (which he estimated to approximate $2,000 a year), until suitable buildings and accommodations were provided by the United States government.

In the summer of 1871 the work of the Commission was established at Woods Hole in temporary quarters on Little Harbor; and Professor Baird secured a group of volunteer asistants from among his friends, including Sidney Smith, Verrill, Farlow, Jenks, Hyatt, and others. A survey of the invertebrates of Vineyard Sound (II, 49) made by Verrill and Smith is useful to this day. An extensive examination of other possible sites for a permanent Atlantic Coast station for hatching and scientific study convinced Baird that Woods Hole combined the necessary advantages to the greatest degree. During the three summers following 1871 he conducted work at Eastport and Portland, Maine, and at Nahank, Connecticut; and in 1875 he again came back to Woods Hole, where a laboratory was fitted up on the government wharf in Little Harbor, of which Baird said in his report (1876): "With the exception of the building erected by Professor Agassiz at Penikese it is the first permanent and formal sea coast laboratory, constructed and put into operation for the purpose, in the United States."

In 1876 the marine laboratory work of the Fish Commission was interrupted, owing to the Centennial Celebration in Philadelphia. From 1877 to 1880 the work was carried on at Salem, Halifax, Gloucester, Provincetown, and Newport. After having tried out all these places, Baird decided that Woods Hole was the best place on the coast for the permanent laboratory of the Fish Commission. In his report for 1882 he wrote: "After a careful consideration of the subject, the choice was found to lie between two stations, Newport and Wood's Hole." The latter was finally chosen because the sea water there was exceptionally pure, i.e., free from sediment or contamination with sewage, and because there were strong tidal currents and no large rivers to reduce the salinity of the water.

Baird undertook to enlist the co-operation of educational institutions and other organizations, as well as individuals, in the establishment at Woods Hole of a national center of biological research; and to this end he proposed that the land for the station be purchased by interested institutions and persons and presented to the government for this purpose. Accordingly, the land and shore line on which the buildings and wharves of the Bureau of Fisheries now stand was bought from Isaiah Spindle for $7,250 and presented to the government as a site for the station. This sum was contributed in the names of the following donors:

The Old Colony Railroad Co.	$2,500
Johns Hopkins University	1,000

Princeton University	1,000
John M. Forbes	1,000
Williams College	500
Alexander Agassiz	500
Isaiah Spindle and Co.	500
Mrs. Robert L. Stuart	250

On this land the buildings of the Woods Hole station of the Bureau of Fisheries were erected in 1885.

Mr. Joseph S. Fay donated the tract of land along the shore extending from the lot of Isaiah Spindle and Company, just referred to, to the grounds of the Pacific Guano Works, thus assuring a long stretch of shore where no building likely to be detrimental to the activities of the Commission could be erected.

Alexander Agassiz, for Harvard University, and the two other universities and the college named made their contributions "with the understanding that, as far as possible they were each to be allowed to send one specialist to the station for the purpose of carrying on scientific work" (report of the United States Fish Commission for 1883). This explains the fact that each of these institutions has the privilege of appointing a representative to a table at the laboratory of the Fisheries Bureau. When, on one occasion, this privilege was canceled by a Commissioner of Fisheries, Mr. Agassiz fought the order with characteristic vigor, and it was rescinded.

Baird encouraged students of zoölogy to come to Woods Hole for work, and thus he established the first group of Woods Hole investigators. Since its establishment, a certain number of scientific workers, fluctuating according to changes of policy, have found accommodation in the laboratory of the Bureau of Fisheries. When, in 1888, the Marine Biological Laboratory was established at Woods Hole by a group of university biologists, although Professor Baird had passed away, the new institution met with cordial support from the Fisheries station and practical assistance in the use of wharves and interchange of services for many years.

IV. The Laboratory at Annisquam

The laboratory at Annisquam, Massachusetts, just north of Gloucester, the true precursor of the Marine Biological Laboratory, arose through the co-operation of the Woman's Education Association of Boston, founded in 1871 to promote the education of women, and the Boston Society of Natural History.

BUILDINGS AND WHARF OF THE WOODS HOLE STATION OF THE UNITED STATES BUREAU OF FISHERIES, BUILT IN 1885; ORIGINAL BUILDINGS (1888–92) OF THE MARINE BIOLOGICAL LABORATORY ON THE RIGHT

Date of photograph about 1895

Louis Agassiz had been an early advocate of the higher education of women; one of the evidences of this was the admission of women on equal terms with men to the Penikese school. There is a natural connection between this fact and the interest of women in the re-establishment of a marine laboratory.

The Woman's Education Association was itself founded in the autumn of 1871 by Mrs. Charles S. Pierce and Mrs. B. F. Brooks to promote the education of women. In response to their circular, seventy-five women became charter members, and three standing committees were set up: intellectual, industrial, and artistic. The work was carried on according to a single plan: any member who had a new idea for education interested a number of friends, who formed a committee; this committee referred its scheme to the president of the Association, who referred it to the Executive Committee. When it was approved by them, it was recommended for adoption. The work was carried on by the first committee with small grants of money; all other funds necessary were raised by them, until the work became so important that it was advisable to form an independent organization to take it over. Among these committees was one on "the teaching of science for women."

In 1873 the Association requested the Massachusetts Institute of Technology to admit women to courses in chemistry, and special laboratories were provided. One of the women first admitted was Miss Susan Minns, who later became one of the founders of the Marine Biological Laboratory.

In the final report of the Association the following account of the Annisquam Laboratory is included:

> In 1879 the teaching of science for women was in its infancy. A committee led by Miss Florence Cushing, a graduate of Vassar, persuaded Professor Goodale of Harvard to give to women a course of lectures in botany with laboratory experiments. This course was successful and the proceeds were given to Dr. Goodale for the erection of a greenhouse for experimental instruction at the botanical garden. The lectures were repeated for several years with a large attendance. Later Professor Alpheus Hyatt of the Boston Society of Natural History gave a course of lectures on animal life. At his suggestion in 1881 a summer school was opened for the instruction of teachers and for research students in marine biology at Annisquam. A "Summer School" was then a comparatively new institution; Professor Hyatt and Mr. Van Vleck gave instruction without pay, and the school was carried on most successfully until 1886, when the committee decided that the number of students was so great that it should be made an independent organization. Therefore, after careful inquiry, in the spring of 1887 the Marine Biological Laboratory at Woods Hole was founded. The Association endowed it with its equipment at Annisquam and made a final gift of $500 [II, 51].

The interest of the Boston Society of Natural History in the establishment of a successor to the Penikese laboratory was, at first, independent. About 1879 or 1880 Professor Alpheus Hyatt, curator of the Boston Society of Natural History, and a student and friend of Louis Agassiz, gave the use of two rooms in his house at Annisquam to several of his pupils, among them Edward G. Gardiner, later clerk of the Marine Biological Laboratory, for study of marine life. For several years he had considered it desirable to found a seaside summer laboratory in connection with the Boston Society of Natural History, and this was a first beginning. The Committee of the Woman's Education Association on the teaching of science for women, led by Miss Florence Cushing, seconded Professor Hyatt in opening a laboratory on a simple scale in a separate building rented for the purpose. Thus the Annisquam Laboratory was opened in 1881 with Professor Hyatt in charge and his assistant, Mr. B. H. Van Vleck, as instructor.

Professor Hyatt stipulated that the policy of the establishment should remain in his hands. No systematic instruction or courses of lectures were to be offered; instruction was to be individual and suited to the preparation of the pupils, who might enter for shorter or longer periods; fees were to be merely nominal, and preference was to be given to investigators. It was a plan not too burdensome to be carried out so long as it proved useful, and one which might later be enlarged into a separate and permanent institution. For the time being, it had the status of a department of the Boston Society of Natural History. The Association and the Society, together, helped to carry the small expense of operation. Professor Hyatt had a fifty-eight-foot schooner, the "Arethusa," built at his own expense for the use of the students.

The laboratory was open for from two to three months each year from 1881 to 1886. A part of the circular of information for the first year and the entire circular of the last year are printed as appendixes (II, A, 8, and II, A, 9). From the records of the Boston Society of Natural History (II, 50) we learn that the attendance was ten women and twelve men in 1881, eight women and six men in 1882, five women and five men in 1883, four women and nine men in 1885, thirteen women and thirteen men in 1886. The response, though somewhat uneven, had been sufficient to demonstrate that the time was ripe for a more ambitious undertaking.

The Society and the Association therefore decided that their ob-

ALPHEUS HYATT (ABOUT 1886)

Curator of the Boston Society of Natural History, First President of the Corporation of the Marine Biological Laboratory (1888–89).

jects in this undertaking had been attained and that the founding of a permanent marine biological laboratory should pass into other hands.

The Woman's Education Association called a meeting composed largely of representative teachers of biology and the fate of the laboratory was surrendered to their deliberations. They decided that an effort should be made to establish a marine biological laboratory, and at least $15,000 should be raised to carry it on for five years. They appointed a body of Trustees and proceeded to solicit subscriptions [II, 50, Vol. 23].

With this the history of the Marine Biological Laboratory may be regarded as beginning.

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CHAPTER III

The Founding and Early History of the Marine Biological Laboratory

I. Early Struggles: 1886–97

THE first step in the foundation of the Marine Biological Laboratory was taken by the Woman's Education Association in accordance with their decision to replace the Annisquam Laboratory by an independent and permanent institution, as mentioned in the last chapter. In 1886 the Association addressed a circular letter to many of the leading biologists of the country and, receiving favorable replies, issued an invitation to a preliminary meeting on March 5, 1887, at the Boston Society of Natural History. This meeting, attended by twenty-two persons, including representatives of the Woman's Education Association and of the Boston Society of Natural History and professors from Harvard University, the Massachusetts Institute of Technology, and Williams College, with singular unanimity and vigor started the movement on its way to success.

A committee of twelve members was appointed by the meeting "to perfect plans for the organization of a permanent sea-side laboratory, to elect trustees and to devise ways and means for collecting the necessary funds." The committee promptly decided that the new laboratory should combine research and instruction, and they appointed seven trustees. An appeal for funds was issued, and a course of lectures on natural history was arranged for the winter of 1887–88. Mr. Charles B. Cory wrote and supervised an original operetta from which a considerable sum was realized, and an additional appeal in the spring of 1888 brought funds of an amount sufficient for a modest beginning. Accordingly, the laboratory was incorporated in March, 1888, in the commonwealth of Massachusetts under the name of the "Marine Biological Laboratory" (III, A, 1; A, 2). The following officers of the corporation were chosen, and Professor Alpheus Hyatt was elected the first president and Miss Anna D. Phillips the first secretary:

TRUSTEES

William G. Farlow
Edward G. Gardiner
Alpheus Hyatt
Susan Minns
Charles S. Minot
William T. Sedgwick
Samuel Wells

TREASURER
William Stanford Stevens

CLERK
Anna D. Phillips

The sum actually raised by these efforts amounted to about $10,000. The subscriptions from eighty-three contributors, including $800 from the Woman's Education Association, amounted to $7,909.50; the lectures brought in $1,485.61, the operetta $431.50, and Mrs. H. D. Wilmarth contributed $100 for the library-to-be. The financial beginnings were small; but faith and hope were high and broadly based in the Massachusetts community, to whom the founding of the Marine Biological Laboratory is to be exclusively credited.

Woods Hole was quickly selected as the site; a piece of land, 78 × 120 feet, was purchased in close proximity to the fisheries station; Professor C. O. Whitman was appointed the first director; and B. H. Van Vleck, instructor. It was decided to begin construction at once and to open the Laboratory in the summer of 1888. A frame-shingled building, 63 × 28 feet, was quickly erected and equipped and was opened for work on July 17, 1888. The Woman's Education Association presented the glassware, boats, furniture, fixtures, and apparatus of the Annisquam Laboratory. The first announcement was not sent out until some time in June (III, A, 3), and the attendance at the first session of the Laboratory was accordingly small—seven investigators and eight students, in addition to the director and instructor.

It was the intention of the first Board of Trustees that the institution should not be simply local in its character but should enlist the active interest and support of the universities and colleges of the country. As evidence of this intention, a circular was prepared in June, 1888, addressed to colleges, which contained the following significant statements:

> The Trustees of the Marine Biological Laboratory earnestly desire to enlist your co-operation in the support of a sea-side laboratory for instruction and investigation in Biology.
>
> It is the desire of the Trustees that the enterprise shall enlist the active support of

the universities and colleges of the country. To prevent its becoming a simply local undertaking, they wish to see all who aid in its support by subscribing to investigators' tables share with the other members of the Corporation in the annual election of Trustees. The Trustees will, therefore, invite each institution which holds an investigators' table to name five persons for members of the Corporation during the term of subscription. The fee for membership in the Corporation has been put at the nominal sum of one dollar a year.

The circular was not widely distributed, and the immediate response was small. However, the intention was later so ably seconded by the first director that co-operation of universities and colleges grew rapidly, though without the privilege of naming members of the corporation, as originally intended; and the national character of the institution was thus assured. This movement of the Laboratory came early enough to avoid the multiplication of relatively small institutional laboratories on the eastern coast to an undesirable extent. It was due to this policy that the Marine Biological Laboratory gradually came to represent over one hundred and fifty institutions each year and that over eighty of them co-operated by subscriptions for the use of facilities (p. 94).

In Professor Whitman the trustees had found a man not only fitted to carry out their purposes but possessing imagination adequate to transform their shadowy ideas, the zeal and determination required to give them form and substance, and the courage to face whatever difficulties might arise. He had an ideal preparation. As student at Penikese in both sessions, he had the benefit of Louis Agassiz's inspiration in 1873 and further training in marine biology in 1874. He studied with the famous zoölogist Leuckart in Leipzig from 1875 to 1878, and received his Ph.D. degree there; for two years he was professor of zoölogy in the University of Tokyo; and on his way back to America he visited Naples and worked for six months (1881–82) at the Zoölogical Station, as guest of the director, Anton Dohrn. Next he was assistant at the Museum of Comparative Zoölogy at Harvard under Alexander Agassiz (1882–86). Following this, he acted as director of the Lake Laboratory at Milwaukee, Wisconsin, founded by Edward Phelps Allis, Jr.; and, while there, he established the *Journal of Morphology*, which set a new standard of excellence for zoölogical publications in America. His appointment as professor of zoölogy at the new research university at Worcester, Massachusetts, founded by Jonas Clark, practically coincided with his appointment at Woods Hole. He had come under the influence of three of the greatest zoölogists of the time, Agassiz, Leuckart, and

Dohrn; was intimately acquainted with the work of the two most important marine laboratories, Penikese and Naples; and at forty-five years of age was full of energy and directed enthusiasm. He was also to prove a wise and inspiring leader.[1]

Professor Whitman clearly outlined his ideas and hopes for the new institution in his opening address (first annual report) and developed them more fully during the next few years (III, 14, 19–24). The all-important requisite in Professor Whitman's opinion was an organized corps of investigators, to be realized in the composition of the Board of Trustees and the membership of the corporation and in the staff and other workers at the Laboratory. The organization should be a national one, uniting universities and colleges in a single endeavor. Research should be the dominant function, but instruction of competent students should be maintained. All biological interests, not only marine, should be welcomed. Progress of science should be the primary consideration; and the economic aspects of biology—for instance, fisheries research—should be regarded as of secondary importance. The control and government of the Laboratory should remain in the hands of professional biologists. The aim was to develop an ideal biological station and a great center of biological research.

Whitman was the person most influential in determining aims and policies. He sought advice and encouragement not only from American biologists but also, by correspondence, from European leaders, among whom may be mentioned Carl Vogt, T. H. Huxley, Anton Dohrn, August Weismann, Rudolph Leuckart, Ernst Haeckel, and E. Ray Lankester. It was encouragement, rather than advice, that he sought (III, 20).

The following quotations from Whitman's early writings will serve to illustrate his ideas. In his first annual report, for 1888, he wrote:

> The new Laboratory at Woods Hole is nothing more, and, I trust, nothing less, than a first step towards the establishment of an ideal biological station, organized on a basis broad enough to represent all important features of the several types of laboratories hitherto known in Europe and America. It should be provided eventually with means for sending men to different points of the coast to undertake the investigation of subjects of special interest, thus adding to the advantages of a fixed station those of an itinerant laboratory.
>
> The research department should furnish just the elements required for the organization of a thoroughly efficient department of instruction. Other things being equal, the investigator is always the best instructor. The highest grade of instruction in any

[1] For a photograph of Professor Whitman at an only slightly later period (1893), the reader may refer to the group photograph on p. 90.

science can only be furnished by one who is thoroughly imbued with the scientific spirit, and who is actually engaged in original work. Whence the propriety—and, I may say, the necessity—of linking the function of instruction with that of investigation. The advantages of so doing are not by any means confined to one side. Teaching is beneficial to the investigator, and the highest powers of acquisition are never reached where the faculty of imparting is neglected. Teaching is an art twice blest; it blesseth him that gives and him that takes. To limit the work of the Laboratory to teaching would be a most serious mistake; and to exclude teaching would shut out the possibilities of the highest development. The combination of the two functions in mutually stimulating relations is a feature of the Laboratory to be strongly recommended [III, 14].

In his lecture on "Specialization and Organization" (1890) he remarked:

Among the ways of bringing together our scattered forces into something like organic union, the most important, and the most urgent at this moment, is that of a national marine biological station. Such an establishment, with a strong endowment, is unquestionably the great desideratum of American biology. There is no other means that would bring together so large a number of the leading naturalists of the country, and at the same time place them in such intimate helpful relations to one another. The larger the number of specialists working together, the more completely is the organized whole represented, and the greater and the more numerous the mutual advantages [III, 19].

In 1893 he wrote, in his lecture on "The Work and Aims of the Marine Biological Laboratory":

To those who by word and example have encouraged co-operation, this record will certainly be gratifying; and perhaps it will be accepted by all as an assurance that good-will and united effort have not been fruitless. For six years the Marine Biological Laboratory has stood for the first and the only co-operative organization in the interest of Marine Biology in America [III, 22].

The same year he remarked, in his article "A Marine Observatory the Prime Need of American Biologists":

The Marine Biological Laboratory attaches itself to no single institution, but holds itself rigidly to the impartial function of serving all on the same terms. It depends not upon one faculty for its staff of instructors, but seeks the best men it can find among the higher institutions of the land. The board of trustees is a growing body, every year adding to its number, until it now comprises a very large proportion of the leading biologists of America. The whole policy is national in spirit and scope. The laboratory exists in the interest of biology at large, and not to nurse the prestige of any university or the pride of individual pretension.

Representative character, devotion to biology at large, independent government,—such are the essential elements of a strong and progressive organization [III, 21].

Again (1896–97) he returned to the theme in an article entitled "Some of the Functions and Features of a Biological Station":

It now remains to briefly sketch the general character and to emphasize some of the leading features to be represented in a biological station.

The first requisite is capacity for growth in all directions consistent with the symmetrical development of biology as a whole. The second requisite is the union of the two functions, research and instruction, in such relations as will best hold the work and the workers in the natural co-ordination essential to scientific progress and to individual development. It is on this basis that I would construct the ideal and test every practical issue.

A scheme that excludes all limitations except such as nature prescribes is just broad enough to take in the science, and that does not strike me as at all extravagant or even as exceeding by a hair's breadth the essentials. Whoever feels it an advantage to be fettered by self-imposed limitations will part company with us here. If any one is troubled with the question: Of what use is an ideal too large to be realized? I will answer at once. It is the merit of this ideal that it can be realized just as every sound ideal can be realized, only by gradual growth. An ideal that could be realized all at once would exclude growth and leave nothing to be done but to work on in grooves. That is precisely the danger we are seeking to avoid.

The two fundamental requisites which I have just defined scarcely need any amplification. Their implications, however, are far-reaching, and I may, therefore, point out a little more explicitly what is involved. I have made use of the term "biological station" in preference to those in more common use, for the reason that my ideal rejects every artificial limitation that might check growth or force a one-sided development. I have in mind, then, not a station devoted exclusively to zoölogy, or exclusively to botany, or exclusively to physiology; not a station limited to the study of marine plants and animals; not a lacustral station dealing only with land and fresh-water faunas and floras; not a station limited to experimental work, but a genuine biological station, embracing all these important divisions, absolutely free of every artificial restriction.

Now, that is a scheme that can grow just as fast as biology grows, and I am of the opinion that nothing short of it could ever adequately represent a national center of instruction and research in biology. Vast as the scheme is, at least in its possibilities, it is a true germ, all the principal parts of which could be realized in respectable beginnings in a very few years and at no enormous expense. With scarcely anything beyond our hands to work with, we have already succeeded in getting zoölogy and botany well started at Woods Hole, and physiology is ready to follow [III, 23].

How these ideas were implemented and developed is the story of the Marine Biological Laboratory. But first we have to relate the history of early struggles centered around the rapid growth of the Laboratory, which involved immediately not only increase of operating expense but also new building, acquisition of more land, adequate living accommodations, and important improvements in facilities for work. The need of a separate lecture-room was acutely felt in the second season; the growth of the library demanded separate space; and addi-

tional accommodations for the growing corps of investigators were urgently needed. Accordingly, an ell was added to the original building for use in the third session (1890). This still proving inadequate, a building the size of the original one and forming a third side of a quadrangle, was added in the spring of 1892 to accommodate classes in general physiology and botany on the first floor and the growing flood of investigators on the second floor. In 1894 a separate building was erected for the botany department at a cost of $3,000 (p. 64); the trustees were engaged, at the same time, in building a dining hall and enlarging the facilities of the "Mess" at a cost of $5,000. In 1896 the last of the wooden laboratories, about the size of the first building, was separately erected to provide a larger lecture hall on the first floor and a series of investigators' rooms on the second floor.[2] A small steam yacht, the "Wyandotte" (later named "Sagitta"), was purchased in the spring of 1890 for the purpose of aiding in collecting beyond the swift currents in the "Hole."

All these and other minor, but expensive, requirements put the trustees under great and constant pressure, to which they responded with steady devotion. After the second year they could congratulate the corporation on the prosperity of the Laboratory. By means of numerous small subscriptions from friends, by students' fees, and by receipts from piano recitals, the budget was balanced. Mrs. Glendower Evans had given $1,000 for the library, and friends in Boston had collected a fund of $2,500 to found the Lucretia Crocker Scholarships at the Laboratory for the benefit of teachers in Boston. In the third year, contributions in excess of $3,000 paid for the ell and the steam launch and, with other receipts, balanced the budget. In the same year Mr. Joseph S. Fay, pioneer summer resident of Woods Hole, aided the Laboratory in the acquisition of the Gifford property, on which the Mess Hall and the Homestead of the Laboratory now stand, by giving $500 toward its purchase and accepting a mortgage note of $3,000 from the Laboratory, most of which was subsequently canceled by him. His daughter, Miss Sarah B. Fay, also furnished the use of two cottages freely.

In 1891 and 1892 contributions from various sources exceeded $9,000; and increase of receipts from students' fees and receipts from contributing institutions, which began in 1892, balanced the budget for three years. In 1893 the trustees could again report great success,

[2] These buildings appear, with others, in the airplane photograph shown on p. 69. They are also included in the plan of central land and buildings, p. 64.

not only in the work but also in the finances of the Laboratory; already they were beginning to look forward to the time when endowment could be secured, but they hoped that the operations of the Laboratory could be stabilized on the existing basis with the generous aid of friends and the active support of colleges and universities. Unfortunately, there could be no such rest, for the pressure for expansion could not be arrested without detriment, as the trustees frankly recognized.

The years 1894 and 1895 were years of great activity, and the attendance rose to one hundred and ninety-nine. The financing of expansion became more difficult. One of the trustees, Dr. E. G. Gardiner, personally advanced $3,000 for the erection of the botany building in 1894. In the same year the active members of the Laboratory, the investigators, feeling that much more remained to be done and that they had a personal stake in the development of the institution, organized the Biological Association, under Dr. Whitman's chairmanship, to aid "in securing funds necessary to the foundation of a Biological Station, as a national center of research in every department of Biology." Over seventy institutions were represented at the meeting, which thus constituted in reality, as Professor Whitman remarked, "a national convention of students, teachers and investigators in Biology." It was planned to form local committees in various scientific centers (III, 14, 1895). The trustees indorsed the plan and authorized approved local committees to raise funds.

In 1895 Professor Whitman, in his report, urged the need for yet another building for lectures and additional research rooms. The Executive Committee of the Board of Trustees supported the recommendation in a formal statement to the Board, and referred to the offer of the Biological Association to aid to the extent of $1,500, provided that the trustees secured an equal sum.

In authorizing the erection of the botany building in 1894 the trustees had voted that "it be declared the policy of the Trustees that no further extension of the temporary laboratories be made, but that if more room for investigators shall be required it shall be obtained by limiting the number of students." When they received the recommendation of the Executive Committee for still another temporary building in January, 1896, a sharp difference of opinion developed; but the vote not to adhere to the policy stated in 1894 was carried by the slender majority of eight to six. Thereupon the trustees voted to erect the new building and to endeavor to raise $1,500 of the required amount, the equal remainder to be furnished by Dr. Whitman. As it

afterward turned out, the entire amount was raised through the efforts of Dr. Whitman and the Biological Association. The building was occupied in the summer of 1896; it was the last of the temporary constructions for laboratory purposes.

Whatever the opposition to the administration that may have existed before among the trustees, this was the first overt demonstration. It is to be noted that all of the six trustees who voted in the negative belonged to the Boston group of nine; three of them were members or former members of the Woman's Education Association. All of them had been concerned with the early foundation of the Laboratory. It is clear that they had begun to feel that control was slipping out of their hands and that they were genuinely alarmed at the financial responsibilities devolving upon the Board.

It is important, at this point, to understand the relationship between the trustees and the "members" who constitute the corporation, for this has been a controlling factor in the history of the Marine Biological Laboratory. The members constituting the corporation proper elect—usually from their own membership—the trustees, who, in their turn, have the exclusive right to elect the members of the corporation. At their first meeting, immediately after incorporation in 1888, the seven trustees elected forty-seven additional members of the corporation, mainly from Boston or its neighborhood, who were interested in the undertaking either on scientific grounds or for other good reasons. The fee, set at one dollar a year, was no impediment to membership. In the second year, life-memberships, with a single fee of $100, were also established. For several years it was the custom to elect to the corporation all workers at the Laboratory who signified their willingness to become members, and the membership grew to three hundred and four regular members and fifty-two life-members by 1894. This was in accordance with the announced policy of nation-wide representation. The result was that the multiplied membership completely lost its Boston complexion. In accordance with the same national policy, additional trustees were elected from Columbia University, Bryn Mawr College, Williams College, Princeton University, the University of Pennsylvania, the Academy of Natural Science of Philadelphia, Yale University, the University of Toronto, the Missouri Botanical Garden at St. Louis, Missouri, and Johns Hopkins University. Thus the dominance of the home city of Boston became lost, both in the corporation and in the trustees. The director was not made a trustee until 1897.

It was originally provided in the by-laws that

> the annual meeting of the members shall be held in Boston on the fourth Wednesday of January in each year, at such time and place as shall be designated by the Trustees; and at such meeting the members shall choose by ballot a Clerk, Treasurer and seven Trustees, who shall hold their offices for one year, and until others are chosen and qualified in their stead [III, A, 2].

The next year the number of trustees was increased to eleven, and the date of the annual meeting was changed to the second Wednesday of November. In 1891 the number of trustees was again increased, to nineteen and two additional members ex officio; but no other changes were made in the by-laws until 1897. Four members constituted a quorum of the Board during all this time, and ten members continued to constitute a quorum of the corporation, although the membership had increased to over three hundred and fifty. However, the privileges of membership were never exercised by the vast majority until 1897. The time and place of meeting rendered this impossible for members of so many institutions, so widely scattered throughout the country.

During the same time the great majority of the workers at Woods Hole, also members of the corporation, had developed a strong spirit of devotion to the institution which was evidenced, among other ways, by the formation of the Biological Association already referred to. The staff and many of the senior investigators were regular attendants at the successive summer sessions, and some had established family summer residences at Woods Hole. These and other members of the corporation were devoted to the director and to the principles of organization that he so constantly held before them in his addresses and in personal conversations. The scene was thus set for them to take control if circumstances should ever warrant.

The occasion for taking control arose in 1897. After the split in the Board over the question of the last temporary building, various disciplinary measures, calculated to insure a greater degree of financial control by the Board, were taken. On the last day of December, 1896, the librarian was instructed to terminate all subscriptions to periodicals; and the director was informed that "owing to the entire absence of funds in the treasury no further indebtedness of any kind can be contracted until further action be taken by the Board." This situation culminated at a meeting of the trustees held in Boston on February 5, 1897, attended by only eight members, all of whom were resident in Boston or Cambridge, who voted, on recommendation of a recently appointed Committee on Ways and Means, "that the Trustees pro-

ceed to raise a sum of not less than $2,000, not later than April 15, and that failing in this attempt the Laboratory be not opened the coming summer."

In these proceedings the director was not consulted; they were, moreover, entirely unnecessary and certainly very prejudicial to the interests of the Laboratory. Mr. L. L. Nunn, one of the trustees, offered to be responsible for any debts incurred in 1897 due to ordinary operations, but the offer was declined "under the conditions imposed." About $1,000 was later pledged in contributions, and outstanding accounts paid in, so that a balance of several hundred dollars became available for future operations. On April 12 the trustees voted to open the Laboratory as "the conditions intended to be met by the vote demanding $2,000 to be raised by April 15, have therefore been met." A reduction of attendance occurred—from one hundred and three students and seventy-four investigators in 1896 to sixty-three students and fifty-eight investigators in 1897—because of the late issue of the announcement and the fact that rumors that the Laboratory would not be opened in 1897 had circulated among those interested. The delaying action was particularly ungracious because Professor Whitman had served as director without any remuneration and because success beyond all expectation had accompanied his efforts. He was in too strong a position to be merely dismissed, and the endeavor to hamper him and the work proved very unwise.

It was obvious that an issue had been raised that could not be compromised. The dissenting trustees—at most, seven or eight out of twenty-one—could have washed their hands of the whole affair by resigning, if they did not feel able to dismiss the director, head and front of the entire offense. There was a movement among them to have the teeth of the corporation drawn by changes in the by-laws making the trustees, legally as well as in practice, a self-perpetuating body, evidenced by a draft of proposed new by-laws inserted in the trustees' minutes book in January, 1896; but there is no evidence that this movement ever received formal consideration either by the trustees or by the corporation. So the summer of 1897 began with the issue unresolved, though not forgotten.

Prior to 1894—that is, for the first five years—no meetings of the trustees or of the corporation had been held at Woods Hole. The wish of the director that at least one meeting of the trustees should be held in Woods Hole each year in order that they might gain some personal knowledge of the operations of the Laboratory was first realized in

1894, and thereafter a summer meeting of the trustees at Woods Hole became the custom. There was evident tension at the meeting held in Woods Hole on August 6, 1897, with eight members present. The meeting convened about two o'clock, and much time was occupied with consideration of the treasurer's report and the election of a large number of members to the corporation. With business still unfinished, three of the trustees felt obliged to withdraw to catch the last train to Boston, and the meeting was continued with five members present.

The discussion then turned to the question of holding the annual meeting of members at the Laboratory in the summer, when representative attendance could be expected. This would require a change in the by-laws; and a motion to call a special meeting of members in Boston on August 16, the earliest legal date, to consider changes in the by-laws, was passed with one dissenting vote. A committee of three was then appointed to prepare a draft of such changes.

The special meeting of the corporation thus called was by far the largest and most representative ever held up to that time; at least eighty-two members, representing thirty-eight institutions, were present. An attempt was made by the acting president, Professor Farlow of Harvard, to show that the meeting had not been called legally, in accordance with the by-laws. When this failed, he withdrew from the meeting. Camillus G. Kidder of New York, a trustee, was elected chairman of the meeting by unanimous vote. Important changes in the by-laws (III, A, 4) were voted. In order to secure a representative attendance of its members, the date of the annual meeting of the corporation was changed from the fourth Wednesday in January to the fourth Tuesday in August, and the Laboratory in Woods Hole was specified as the place of meeting. Special meetings of members might be called by the trustees either in Woods Hole or in Boston. The number of trustees was set at twenty-four in order to preserve a wide representation of institutions; and, instead of being elected at one time for a single year, they were divided into four classes of six each, of which only one class was to be elected each year for a term of four years. The quorum was raised from four to six for meetings of trustees. Finally, a committee of three was appointed to present nominations for a clerk and for twenty-four trustees, divided into four classes of six each, to be elected for terms of one, two, three, and four years initially, and thereafter for four-year terms.

In accordance with these changes in the by-laws, the annual meeting of the corporation was held in Woods Hole on August 24, 1897,

with a large attendance. The proceedings of the special meeting of August 16 were ratified and approved, including the changes in the by-laws; and certain minor changes were also incorporated (III, A, 4). Twenty-four trustees were elected in groups of six, each to serve, respectively, one, two, three, and four years; with three ex officio members, viz., the director, assistant director, and clerk of the corporation, the new Board consisted of twenty-seven members (III, A, 5). Of the nine Boston members, after withdrawals or resignations following re-election, only two remained on the new Board, which now consisted of twelve old and fifteen new members, representing fifteen universities and three independent scientific institutions.

Six of the Boston trustees and one other then united in a statement, published in *Science*, reflecting severely upon the financial conduct of the Laboratory by the director, to which an extended answer was made in the less public form of a pamphlet of twenty-seven pages, prepared by S. F. Clarke, E. G. Gardiner, and J. P. McMurrich, trustees, and distributed to members of the corporation, friends of the Laboratory, and others. Those who are interested in the controversy will find reference to the documents in the bibliography (III, 5, 18). The wounds were deep and healed slowly, but they have left no permanent mark.

Was this conflict inevitable? No one can impugn the standing or devotion to science and education of the persons principally concerned. The Boston trustees were responsible for the foundation of the Laboratory, and they met the deficit in cost of operation and raised funds for land and buildings without protest during a period of at least six years; and during the same time they expressed their satisfaction with the growing reputation and success of the Laboratory. The director and staff showed their devotion to the cause by unremitting and unselfish efforts; and they were responsible, much more than the trustees, directly instead of indirectly, for the scientific and educational success of the enterprise. The issue between the original trustees and the management was really one between ingrained cautious conservatism and confident progressivism. The management had more faith and a broader vision. Perhaps, if they had been able earlier to relieve the trustees of more of the burden of support, the issue might not have been so sharp. But it is doubtful whether the original trustees could ever have entered enthusiastically upon the untrod path of co-operative effort in science and education on which the management had set its feet.

II. Intermediate Planning, 1898–1902: President Harper and the "Chicago Plan"; the Carnegie Institution

After the crisis of 1897 the annual meetings of the trustees and corporation were held at Woods Hole, and all traces of local control disappeared. The enlarged Board of Trustees included professors from nine eastern, four midwestern, and two Canadian institutions. There were also three nonprofessional members: the new treasurer, D. Blakeley Hoar of Boston, a devoted adviser in business affairs; Camillus G. Kidder, a distinguished lawyer of New York; and L. L. Nunn, of Telluride, Colorado, electrical and mining engineer. The main result of the crisis had been to secure freedom of development, according to the original plan of a national co-operative organization, and to arouse and spur on the original enthusiasm; it was really a second birth. Both the trustees and the director knew that they were faced with a difficult problem to preserve and develop the institution; it was their function to seek new sources of support.

The financing of the ordinary operations of the Laboratory presented a difficult but not insuperable problem. Receipts from fees and the growing business of the supply department, which furnished preserved specimens to colleges and universities, came near to meeting operating expenses; and any temporary lack of funds was met by donations and small loans. But considerable improvements and expansion of existing facilities were out of the question. Hand-to-mouth existence was irksome in itself, and the conviction that the Laboratory had an important role to play was growing instead of diminishing (III, 6). Attempts to raise more funds by direct appeal were at first not very successful.

A serious attempt was made in 1900 to induce universities and colleges that profited by use of the Laboratory to underwrite a larger share of the costs of operation. There were then twenty-four co-operating institutions that subscribed from $100 to $300 a year for the privilege of free places in classes or research accommodations. The hope was entertained that a few of the stronger institutions might be willing to make pledges for five years in advance, at the rate of $500 a year, in return for a larger measure of control in the government of the Laboratory. This plan, if successful, could gradually be extended to include more governing institutions. Preliminary discussions were begun with several institutions, with some hope of success.

At a meeting of the Board of Trustees held in December, 1900, the Executive Committee was instructed to confer with eight such univer-

sities "to see if by a revision of the existing organization of the Laboratory and of the by-laws closer relations between universities and the Laboratory might not be brought about." The Laboratory, on its part, was prepared to agree to a separation of financial and scientific management by intrusting the former to a small independent board if necessary. In any event, the institutions composing the oligarchy were to be entitled to name their own representatives on the Board of Trustees of the Laboratory.

It was soon realized that, even with the greatest contemplated success of this undertaking, the income to be received would not be adequate for development beyond the existing status. In consequence, independent efforts were made by trustees in the Middle West and in the East to develop a more promising plan.

These efforts bore fruit in 1901 and 1902 in two separate and distinct offers to relieve the trustees of the Laboratory of the main burden of financial responsibility for operation and enlargement of the institution. In each case this was predicated upon relinquishment of financial control by the trustees and members and placing it in other hands. The offers showed confidence in the scientific competency of the organization but doubts of its ability to handle financial affairs—doubts which, it is only fair to say, were shared also by the membership. Coming, as they did, from two influential sources, the offers were a heartening recognition.

The first offer was made by Mr. A. C. Bartlett of Chicago, Mr. Charles Coolidge of Boston, Mr. C. R. Crane of Chicago, and Mr. L. L. Nunn of Telluride, Colorado, through President W. R. Harper of the University of Chicago, in a letter addressed to the director:

Prof. C. O. Whitman,
Woods Holl, Massachusetts

My dear Sir:

Upon several occasions members of the body of Trustees of the Marine Biological Laboratory at Woods Hole have suggested, and indeed, urged, the necessity of a reorganization of that body in some such manner as to make provision for a stable business foundation. These statements, made by yourself, and others, have been under consideration for a period extending over two years. I am authorized by a company of gentlemen, including Mr. A. C. Bartlett of Chicago, Mr. Charles Coolidge of Boston, Mr. C. R. Crane of Chicago, Mr. L. L. Nunn of Telluride, Colorado, to say through you, to the Trustees of the Marine Biological Station, 1. That they will consent, with others, if so requested to do, to assume the responsibility of Trustees of the Marine Biological Station. 2. That, if elected Trustees, they agree to undertake to make reasonable provision for the work of instruction and research in the various lines

established; this provision to include the purchase of additional ground, the building of a laboratory, and an effort to make some form of the work continuous throughout the year. 3. That in direct furtherance of this plan they agree to provide ten thousand dollars for the expenses of the Marine Biological Station during the first year, (i.e. the year beginning January 1st, 1902), this sum being understood to be in addition to any money received as tuition fees in connection with the work of the station.

I am also directed to say: 1. That this proposition carries with it the understanding that the Trustees thus appointed shall be a self-perpetuating body and may be permitted to increase, at pleasure, the number. 2. That the present body of Trustees, at the option of the Association, shall continue as an advisory scientific staff. 3. That, as thus reorganized, the new Board of Trustees will sustain the same relation to the work at Woods Hole as is ordinarily sustained by a Board of Trustees to an institution of learning, a hospital, or an institution of research

It is with a clear appreciation of the responsibilities involved in this work that the gentlemen whose names are given above stand ready to assume this burden. I think it is not necessary to say that they are gentlemen who would not undertake work of this kind without a full determination to make the work a successful one.

I desire to repeat that this statement is made in reply to urgent and repeated requests made by the individual members of your Board of Trustees.

I remain

Yours very sincerely,

William R. Harper.

August 2, 1901.

President Harper's letter was received in ample time for consideration by the Board of Trustees of the Marine Biological Laboratory at their annual meeting on August 13. It was thoroughly discussed both before and at the meeting. Indeed, the plan had been gradually developed by Professor Whitman, in consultation with President Harper and with the advice of other trustees of the Marine Biological Laboratory, over a period of about two years, as demonstrated by Professor Whitman's correspondence. The trustees were therefore ready for the prompt action covered by the following letter:

August 13, 1901

Dr. W. R. Harper
President of the University of Chicago

Dear Sir:

The Board of Trustees of the Marine Biological Laboratory acknowledge the receipt of your communication of the 2nd. inst., through Prof. Whitman, concerning the reorganization of the Board in such manner as to provide for a stable business foundation. And they desire to express to yourself and through you to Mr. A. C. Bartlett of Chicago, Mr. Charles Coolidge of Boston, Mr. C. R. Crane of Chicago, and Mr. L. L. Nunn of Telluride, Colorado, their grateful appreciation of the generous proposal made in your letter. The plan presented on behalf of these gentlemen for the maintenance and growth of the Laboratory is one that commends itself to the present board; and its members pledge themselves to co-operate with yourself and the gentlemen named to ensure its success. To this end Mr. Bartlett, Mr. Coolidge, Mr. Crane

and Mr. Nunn have been elected members of the present board of Trustees, and the Corporation of the Marine Biological Laboratory has voted to this board full power to modify in any way the by-laws of the Corporation, thus making it possible to carry the plans to completion at the next meeting of the board to be held in Chicago during the last week of December, 1901.

This is the fourteenth session of the Laboratory; during its entire existence the Laboratory has stood steadily for two ideals:—1. The furtherance of Biological Research. 2. As a means to this end the establishment and maintenance of a national character, through the co-operation of Universities, Colleges, and Scientific Bodies, avoiding, however, any one-sided alliances that might alienate large numbers of scientific men. The list of publications made by members of the Laboratory is evidence of success in research; and the composition of the board of trustees, and the steadily growing list of co-operating Societies, Universities, Colleges, and of Institutions represented by members of the Laboratory fully establish our claim to be a national institution. The board of trustees regard these matters as fundamental and desire to preserve both the research spirit and complete independence, forming alliances with all scientific bodies, but amalgamating with none.

The Board of Trustees are therefore of the opinion that it is desirable that the proposed increase of the new board should make it as representative as possible of all interests centering in the Laboratory, and think it would be desirable to have a distinct understanding concerning the future status of the Laboratory.

On the completion of the proposed board the Trustees of the present board will vote to it the full powers of the Corporation and Trustees, and will provide for their own continuance as an advisory council with functions to be defined in consultation with the proposed board.

[*Signed*]

C. O. Whitman

Samuel F. Clarke	Charles W. Hargitt
Christian A. Herter	Wm. A. Locy
Edward G. Gardiner	Thomas Hunt Morgan
Jacques Loeb	Frank R. Lillie

The three gentlemen named by President Harper, in addition to Mr. Nunn, who was already a trustee, were elected members of the Board. The principles of the national, independent, and co-operative organization of the Laboratory were stressed; and the trustees pledged themselves to transfer necessary powers to the new Board whenever the proposed increase of its members should make it fully representative of all interests concerned and the functions of the proposed advisory council to be composed of members of the existing Board should be defined. The offer was thus accepted in principle; and the corporation, at their meeting on the same day, voted necessary powers to the Board to carry the plan to completion.

At the next meeting of the trustees, held in Chicago on January 2, 1902, a completely new set of by-laws (III, A, 6) was presented and

adopted, subject to ratification by the trustees at a special meeting to be held in the state of Massachusetts. These presented the familiar feature of financial control by a relatively small, self-perpetuating Board of Trustees, but with special features intended to secure independent scientific control through a "Scientific Council" of limited numbers with right to nominate the director, approve changes in the by-laws, and perform advisory functions. At a special meeting for purposes of ratification, held in Boston, January 11, 1902, a bare quorum of seven members was present, and the director was absent. On this ostensible account, action on ratification was postponed for consideration at another special meeting, in February; and President Harper was requested to furnish a more definite statement of the plan and wishes of the gentlemen named by him.

There were both negative and positive reasons for these dilatory tactics. There is no doubt that apprehension existed in the minds of some of the trustees of the Marine Biological Laboratory lest consummation of the plan proposed in President Harper's letter should tend toward control by a single university, namely, the University of Chicago, at that time rapidly expanding under the inspiration of its great first president. This apprehension was sometimes expressed in blunt language. On the positive side, there was the hope of securing at least equal aid from the newly established Carnegie Institution if the situation remained unprejudiced.

President Harper did not speak for himself or for the university of which he was president, but for the four gentlemen whom he named. In reply to the request of the trustees, cited above, for a more definite statement he reaffirmed their intention to maintain the independent status of the Laboratory.

CHICAGO, January 28th, 1902.

Mr. E. G. Gardiner
131 Mt. Vernon Street
Boston, Massachusetts

MY DEAR SIR;

In reply to a letter from the Board of Trustees of the Marine Biological Laboratory, under date of August thirteenth, 1901, and to the resolutions of their meeting under date of January eleventh, 1902, I desire to say: That, in conference with the gentlemen named in my former letter, I am informed by them, first that they accept the by-laws of the corporation, as passed at a meeting of the Board of Trustees of the Marine Biological Laboratory held in Chicago January second, 1902, as limiting their trusteeship. Second, that, as before stated, they would undertake to make reasonable provision for the work of instruction and research in the various lines established, this pro-

vision to include the purchase of additional ground, and the building of a permanent laboratory, and an effort to make some form of the work continuous throughout the year. In direct furtherance of this plan, to provide, for a period of five years after and including the year 1902, a sum of not less than ten thousand dollars a year in addition to all income from fees, rental of rooms, sales of supply department, et cetera. Third, the gentlemen agree with the principle stated in the letter of August thirteenth, 1901, that it is desirable that the proposed increase of the new board should make it as representative as possible of all interests centering in the laboratory. They consider that the future status of the laboratory as an independent institution is guaranteed by the acceptance of the by-laws.

So far as I understand the purpose of the gentlemen named, they would plan to retain unaltered so far as possible the previous policy of the laboratory, and would hope to retain the support of all colleges, societies, and laboratories heretofore co-operating, and would endeavor to secure the co-operation of others.

You will of course appreciate the embarrassment caused by an effort on my part to represent these gentlemen. At the same time I think I have fairly expressed their position, I remain

William R. Harper.

The idea of disturbing the national, independent status of the Laboratory was certainly not in the minds of the gentlemen on whose behalf President Harper wrote, for three of them served for long years as trustees and benefactors of the Marine Biological Laboratory after President Harper's plan was discarded; one of them, indeed, Mr. C. R. Crane, acted as president of the corporation for over twenty years (1904–24). It was also inconceivable that Dr. Whitman should falsify his consistent stand for a national organization. Everything that followed afterward shows that President Harper was equally free from an intention of securing control by his university. The proposal, never actually adopted, was a characteristically generous impulse on his part.

The hope of support from the Carnegie Institution was revealed at a meeting of the Executive Committee of the Board of Trustees held in New York on February 1, 1902. At this meeting, in addition to the five members of the Committee, four other trustees were present by invitation. Professor H. F. Osborn, president of the corporation, laid before the meeting certain reasons why it seemed probable that the Marine Biological Laboratory might receive important aid from the Carnegie Institution. A committee of four trustees, including H. F. Osborn and E. B. Wilson, was then appointed to confer with the Executive Committee of the Carnegie Institution.

The Carnegie Institution had been incorporated on January 4, 1902, and the deed of trust from Andrew Carnegie conveying ten million dollars in bonds of the United States Steel Corporation to the

trustees of the Institution was executed on January 28. The announced purpose of the trust was to encourage investigation, research, and discovery in the most liberal manner possible. On January 30 the Executive Committee of the Institution appointed eighteen advisory committees in various branches of learning, of which that in zoölogy was headed by H. F. Osborn, president of the Board of Trustees of the Marine Biological Laboratory. E. B. Wilson, also a trustee, was another member. It will be seen, therefore, that the Marine Biological Laboratory was early on the ground.

Osborn and Wilson, acting for the Executive Committee of the Laboratory, met the Executive Committee of the Carnegie Institution informally on February 8 and placed before them all the principal facts regarding the past history and the present status of the Marine Biological Laboratory and asked their consideration of the following three points:

> First: The general question whether the Carnegie Institution would support the Marine Biological Laboratory with the intention of placing it on a permanent basis as a representative national research laboratory.
>
> Second: The specific question of support for the laboratory for the coming summer.
>
> Third: The best practicable organization of the laboratory that would commend itself to the Carnegie Institution as an assurance of its national representative character [III, A, 7].

The matter was then discussed at a later meeting of the Executive Committee of the Carnegie Institution on March 11, 1902, at which Dr. J. S. Billings was appointed "to investigate and report upon the desirability of the Carnegie Institution making a grant for the maintenance of the Marine Biological Laboratory at Woods Hole, Mass." For this purpose he conferred with Dr. Wilson and laid down conditions under which the Carnegie Institution might be prepared to place the Laboratory on a permanent basis.

A special meeting of the Board of Trustees of the Marine Biological Laboratory was then called on March 22, 1902, to consider the prospect. The trustees acted by appointing a conference committee of six members, consisting of Messrs. Whitman, Crane, Nunn, Hoar, Herter, and Wilson, to meet with the Executive Committee of the Carnegie Institution. This committee acted under the following resolutions which constituted a commitment of a provisional character:

> 1. *Resolved* that the Trustees approve the incorporation of the Marine Biological Laboratory by the Carnegie Institution on the lines indicated in the letter of Dr. Bil-

lings, and that the chair appoint a committee of six, including himself, to confer with the Executive Committee of the Carnegie Institution and make such arrangements as are deemed advisable and necessary regarding the legal incorporation, the personnel of the new board and the manner of conducting the Laboratory in the future. This committee to report to the present board for final action as soon as practicable.

2. *Resolved* that it is the sense of this meeting that it is desirable that the incorporation be so conducted as to leave open and invite co-operation of the present friends and supporters of the Laboratory and others.

Copies of the above resolutions were promptly forwarded to the Executive Committee of the Carnegie Institution and were considered by them in a meeting on March 25, 1902. They adopted a set of resolutions (III, A, 8) approving the "acquirement of the Woods Hole Laboratory by the Carnegie Institution, with the understanding that the Trustees of the Laboratory are willing to turn over its plant to the Institution, provided the latter will undertake the maintenance and support of the Laboratory"; and they made a grant of $4,000 to the trustees of the Marine Biological Laboratory, payable on or after August 1, 1902, as a contribution toward the expenses of the Laboratory during the approaching session "if satisfactory evidence is furnished to the Executive Committee that the Trustees of the Woods Hole Laboratory have full power to transfer the property of the Laboratory to the Carnegie Institution, and have agreed to do so." This contribution was later received and used. It was the first grant for scientific purposes authorized by the Carnegie Institution (III, 3).

The Carnegie Institution also appointed a conference committee of three—John S. Billings, A. S. Hewitt, and S. Weir Mitchell—which met with the conference committee of the Marine Biological Laboratory in New York on April 11, 1902. In the course of this meeting, the Carnegie representatives were asked if they would accept a joint board of trustees representing equally the Marine Biological Laboratory and the Carnegie Institution. They stated that they could not accept divided control and that, if the Marine Biological Laboratory desired to remain separate and independent, the Institution might from time to time make separate grants to the Laboratory. Following this, the conference considered by-laws previously prepared by representatives of both institutions to be used in case of acceptance of the offer of the Carnegie Institution. A second meeting of the two conference committees was held on May 31 (III, A, 10).

In the meantime, Professor Whitman had addressed a circular letter to the trustees of the Marine Biological Laboratory (III, A, 9) in which he presented in strong terms the position that he, Mr. Crane, and Mr.

Nunn had maintained consistently in the meetings of the two conference committees, to find a way of combining both sources of support and preserving the independence of the Laboratory. He maintained that the resolutions passed at the meeting of the trustees on March 22, which he himself had presented, "were intended not to bind us irrevocably, but to prepare the way for *securing co-operation in the support of the Laboratory.*" This was evidenced by the appointment of two of the trustees of the proposed "Chicago plan," Messrs. Crane and Nunn, to the conference committee. The intention is also made plain by careful reading of the resolutions.

The members of the Marine Biological Laboratory on the conference committee then made a detailed factual report, about June 1, 1902, in a circular letter signed by all of its members and addressed to the trustees of the Laboratory (III, A, 10). Certain changes in the proposed by-laws were recommended, and the whole matter was to be considered by the Marine Biological Laboratory trustees at Woods Hole in the summer.

A special meeting of the Board of Trustees of the Marine Biological Laboratory was held at Woods Hole on July 19, 1902. At this meeting the by-laws proposed by the Executive Committee of the Carnegie Institution for the government of the proposed Department of Marine Biology (viz., the Marine Biological Laboratory), together with the proposed amendments thereto, considered and approved by the Conference Committee of the two bodies, were taken up and discussed article by article. Amendments proposed and unanimously approved were recommended to the Executive Committee of the Carnegie Institution (III, A, 11). The treasurer was thereupon authorized and instructed to execute a deed, which was presented and approved by the trustees, conveying all the property of the Laboratory to the Carnegie Institution. Inasmuch as the final power to effect the transfer rested with the corporation, a committee of five members (Cornelia M. Clapp, E. G. Gardiner, C. O. Whitman, E. B. Wilson, and Frank R. Lillie, chairman) was appointed to report the entire situation to the corporation. They accordingly drew up a report, signed by all the members, recommending confirmation of the actions of the trustees at the regular annual meeting to be held August 12, 1902, at Woods Hole. This report was printed and distributed to all members of the corporation on July 28, 1902 (III, A, 12).

The annual meeting of the corporation of the Marine Biological Laboratory was held on August 12, 1902, following a meeting of the

trustees at which the trustees had adopted the report of the committee to the corporation as its own. The deed conveying all the property of the Laboratory to the Carnegie Institution was read to the corporation and discussed; and, when the motion was put, sixty votes were cast in favor of the transfer and three against. Thus the transfer appeared to be finally consummated, lacking only formal acceptance by the Carnegie Institution. On August 14 the result was announced *in extenso* by Boston newspapers (III, 2).

At their special meeting on July 19 the trustees of the Laboratory had appointed a committee to draw up a report of plans for the future development of the Laboratory to be presented to the Carnegie Institution for its consideration. It had been suggested during the summer by members of the Executive Committee of the Carnegie Institution that the report should include an ideal plan, limited in extent and cost only by wise consideration for the future development of marine biology, as well as a practical plan based on an estimate of about $80,000 for land, buildings, and permanent equipment and an income for maintenance of from $20,000 to $30,000 a year.

This report was accordingly prepared and transmitted to the Carnegie Institution on September 20, 1902. The preamble contained the following significant statement:

> Some of the undersigned are, however, of the opinion that had the trustees and corporation of the Marine Biological Laboratory realized the possibility of receiving any adequate unconditioned support from the Carnegie Institution, their action might have been different. They therefore wish to reserve the right to declare their preferences in another place provided it should seem advisable later to do so. In case such a statement were to be made, it would be presented before the November meeting of the trustees of the Carnegie Institution.

It also contained a statement on the scope and aims of the Marine Biological Laboratory by Professor Whitman, with characteristic emphasis on the necessity of freedom of development for the life of the Laboratory.

So far, the conditions under which the Carnegie Institution would take over and administer the Marine Biological Laboratory as one of its departments had not been made very clear; the vote of the corporation of the Marine Biological Laboratory to transfer to the Institution all of its property on the basis of a merely general understanding was therefore a signal mark of confidence on the part of the Laboratory and was felt to be so by the Carnegie Institution. Apparently the Institution had failed to understand fully the deep-seated character of

the divergence of opinion within the membership of the Laboratory; and, when they began to realize it, as a result of the report rendered to them and of discussions both public and private, they decided to refer the whole situation back to the Laboratory.

The events that led to this decision and to the denouement were as follows: Professor J. McKeen Cattell, of Columbia University, editor of *Science*, acting with his characteristic vigor, honesty, and courage, was one of those who, as a member, opposed the action of the corporation of the Marine Biological Laboratory at their meeting in August. On September 19 he published an article in *Science* (III, 4) concerning policies which it would be desirable to establish in the Carnegie Institution, in which the acquirement of the Marine Biological Laboratory by the Carnegie Institution was opposed as likely to be injurious to both institutions. Professor Whitman had submitted an article on the subject to Dr. John S. Billings, representing the Executive Committee of the Carnegie Institution, which he proposed to publish; but Dr. Billings' reply led him to withdraw it. However, after publication of the Cattell article, Dr. Billings wrote to Professor Whitman withdrawing his objections; and the article, entitled "The Impending Crisis in the History of the Marine Biological Laboratory," appeared in *Science* on October 3 (III, A, 13). Professor Whitman interpreted the action of the corporation on August 12 as essentially a vote of confidence in the Carnegie Institution and pointed out that "only our part of the situation was entirely definite."

This led the Executive Committee of the Carnegie Institution to make a definite statement on October 4 of the principles that would govern them in recommendations to the trustees of the Institution (III, A, 14). This statement was immediately transmitted with a covering letter to the acting secretary of the trustees of the Marine Biological Laboratory, Professor E. B. Wilson, and by him, in turn, submitted to all the trustees.

Of the principles stated, the main features that occasioned some surprise and disappointment to many of the trustees of the Marine Biological Laboratory were the requirement that instruction should be eliminated from its activities and the fact that provision for buildings, boat, and maintenance was much less than expected. To base the operations on the model of the Naples station, however great the respect felt for this institution, was also felt to be a serious limitation. If the Carnegie Institution could decide in advance that the historic policy of combining instruction with research could not be approved

(item 2 of their statement), what value could be attached to the control of operations and the advisory functions of the "Board of Managers" provided for in the sixth article of the proposed by-laws (III, A, 11)? This and other pronouncements in their communication of October 4 (III, A, 14) indicated that after the controversy they preferred to withdraw from their original commitment. The way out that they offered to the Marine Biological Laboratory, viz., to grant aid to the Laboratory at the rate of $10,000 a year for a period of three years, was an easy path for the time.

The time set for reply to the proposal of the Carnegie Institution—by October 25—was short; and the decision had to be made by the Executive Committee of the Marine Biological Laboratory. Wilson's report on the replies of twenty-one trustees to the Carnegie statement of October 4 showed five unconditionally in favor of the conditions stated and sixteen in favor of the alternative offer of a grant of $10,000 a year for a limited period. This was duly considered by the Executive Committee, and a majority of its members—three in number—joined in the following report:

MAJORITY REPORT OF THE EXECUTIVE COMMITTEE
OF THE
MARINE BIOLOGICAL LABORATORY
TO THE
EXECUTIVE COMMITTEE OF THE CARNEGIE INSTITUTION.

The undersigned members of the Executive Committee of the Marine Biological Laboratory, deeming it impossible to obtain a meeting of the Trustees of the Laboratory in time to return an answer, before Oct. 25th, to the resolutions of the Executive Committee of the Carnegie Institution made at their meeting at the Fifth Ave. Hotel, New York City, Oct. 3 and 4, 1902, beg to reply for the Trustees of the Marine Biological Laboratory as follows:—

1. That the general principles stated in the communication of Dr. Billings, that would govern the Executive Committee of the Carnegie Institution in its recommendations as to the Trustees of said Institution, are in some essential respects so different from anything that has been hitherto considered by the Corporation and Trustees of the Marine Biological Laboratory, that they would not feel justified in authorizing the transfer of the property of the Corporation without adequate reconsideration by that body and the Trustees.

2. They therefore desire to state their opinion, that the Marine Biological Laboratory should for the present retain its independence.

3. In pursuance of the suggestions of the sixth article of the communication of the Executive Committee of the Carnegie Institution, the Executive Committee of the Marine Biological Laboratory would respectfully request a grant of 10,000 dollars a year for a period of three years, the Marine Biological Laboratory on its part agreeing

to place twenty research tables at the disposal of the Carnegie Institution, the occupant of each to be furnished with supplies and material substantially as is done by the Naples Laboratory.

C. O. Whitman
F. R. Lillie
Oct. 24th, 1902. Jacob Reighard.

The other two members of the Executive Committee, in a minority report, agreed with the majority that the transfer of the Laboratory to the Carnegie Institution was for the present inexpedient and concurred in asking for a grant of $10,000 a year; but they did not agree with the first statement in the majority report. They hoped that the matter might come up for reconsideration at a later time. Application for a grant of $10,000 a year to the Carnegie Institution for three years—1903, 1904, and 1905—in return for the assignment of twenty tables each year to the Institution was accordingly made and was approved by the Institution. At the end of the period of three years, application for continuation was declined; and the Carnegie Institution established its own department of marine biology at Tortugas, Florida, under the directorship of Alfred G. Mayor.

If ever courtesy and mutual respect were rewarded, this was notably the case in the relations between Dr. Billings and Dr. Whitman. To quote from Dr. Billings' letter:

> The generous act of confidence in the Carnegie Institution by the Trustees and Incorporators of the Marine Biological Laboratory at Woods Hole in offering to turn over their property without definite conditions, has been highly appreciated by the Executive Committee, and I hope it will be clearly understood by the Trustees that this action of referring the matter back to them for further consideration, is intended only to give them a full opportunity for considering the whole question anew, if they so desire, after understanding the action which the Executive Committee proposed to take in its recommendations to its own Board of Trustees [III, A, 14].

The differences of opinion between Whitman and Wilson led to a polite controversy in *Science* (III, 16); Gardiner and Cattell also exchanged verbal blows in the same arena (III, 17), but no heads were broken; and all positions were explained.

The independence of the Laboratory was preserved, thanks to Professor Whitman's persistence and the support that he earned and received within the organization. The second crisis in the history of the Laboratory, in which counsels were divided, was past. The result was received with a general, if not unanimous, sigh of relief. The temper of the proceedings was creditable to all the parties concerned, animated as they were by a sincere desire to promote the interests of science in a

way best suited to the existing situation of the Marine Biological Laboratory. Opinions differed respecting ways and means of securing this end; but, though somewhat tinged with emotion, they did not become acrimonious and were not the occasion of rupture of friendly relations. The principles of independence, of national organization, and of administration by scientific workers were not thereafter to be challenged. They were, indeed, reasserted thirty-six years later by the trustees of the Laboratory in a special report (III, 14, 1938) defining policies with reference to plans for future development.

The whole experience was somewhat disillusioning to Professor Whitman; although he had found abundance of personal devotion, there were but few who held with anything like equal intensity his belief that the ideals of organization for which he had fought were of value far superior to any degree of financial security. Although his convictions had never wavered, his loyalty to his associates led him to a degree of compromise during the proceedings which it was painful to him to grant. In a letter to one of the trustees written in November, 1902, he said:

> If the new turn of events is somewhat of a trial to you, don't forget that I have had during the year more than one trial quite as severe. The corporation meeting—to mention but one—was a bitter trial to me, for I felt that the action contemplated was to be final, and that it would prove fatal to long-cherished hopes.

However, he ended the year on a note of exultation in a long circular letter to the trustees. It began:

> The new year brings the blessings of a defined situation. In this there is a quieting sense of security—just a little rest for the optimists, a little peace for the pessimists. Providence has evidently intended to extend the period of our probation, and to hold us, *nolentes volentes*, firmly to *terra firma*. . . . . Whether for better or for worse, we are left with our humble possessions all our own, with all the vexatious responsibility of independence, with all the agony of our old incentives to pull and sweat and pray together, with little hope of ever moulting our restless anxieties this side
>
> "That undiscovered country, from whose bourn
> No traveler returns."

Following this (III, 12), Whitman gradually withdrew from active participation in the management of the Laboratory, although he retained the title of director until 1908. However, he no longer attended meetings and was even absent from the Laboratory for two successive seasons, 1904 and 1905. The house which he had occupied at Woods Hole burned down in the winter of 1905–6; and, fearing that this would make his return impossible, his friends raised a sum of

$3,000 by subscription and the property was bought and the house restored and presented to Whitman. This very signal mark of love and appreciation on the part of his friends, indicating, as it did, so clearly their desire to remove every obstacle that prevented his presence among them, touched Whitman most deeply. He was present again at the Laboratory in the sessions of 1906 and 1907, but never again except for a brief visit of two or three days in 1909. He died on December 6, 1910, in Chicago.

This chapter is a record of struggle and recurring crises in the first fourteen years of the history of the Marine Biological Laboratory. They were stormy years in which fundamental principles of organization were confirmed and established. The crisis of 1897 witnessed the end of local control and the establishment of nation-wide control. The proposal for an oligarchical control by a few strong institutions met an adverse fate soon afterward, and with this expired also the idea of institutional membership. For a time the conception of separating financial and scientific control seemed to be in the ascendancy, but it met with a similar rejection in the failure both of the Chicago plan and of that of the Carnegie Institution in 1901 and 1902. From that time on, the principle of free co-operation, as described in Chapter V, has prevailed peacefully, and steady progress has been made. It has seemed worth while to relate the early struggles in some detail for the benefit not alone of members of the organization but also of those interested in forms of educational organization.

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CHAPTER IV

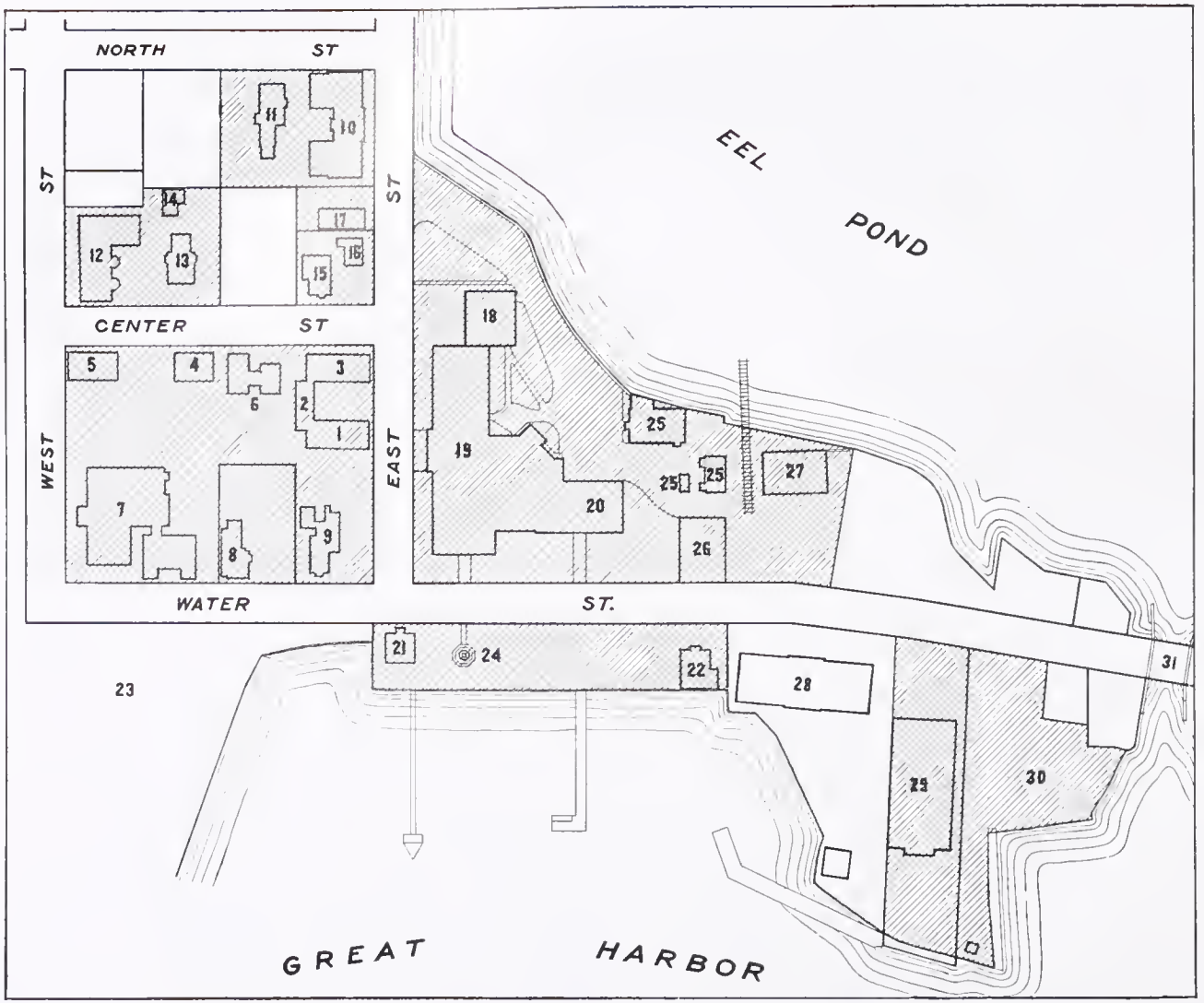
The Material Growth of the Marine Biological Laboratory

IN PLANNING for the future growth of the Laboratory after the turn of the century it was essential to acquire land for scientific purposes, for harbor frontage (previously the hospitality of the United States Fish Commission had been depended upon), and for residence requirements of students and investigators, for whom local accommodations were entirely inadequate. It was also important, during the period when a large part of the budget had to be covered by donations, to provide, by self-help and by endowment, for an ultimately balanced budget. If the Laboratory were to continue to be a satisfactory place for work, it was necessary to meet the growing requirements of experimental biology, especially in biochemistry and biophysics, not only for equipment and supplies but also for buildings of stable construction, free from vibration; and, if the Laboratory were to continue to represent a good cross-section, at least, of the biological activities of the country, which were increasing at a very rapid pace, additional space for investigators had to be provided. These general requirements involved a very large number of special needs.

I. Land

The Laboratory started with a single lot, 78 × 120 feet, in 1888 (1, 2, 3).[1] Two years later, with the help of Joseph H. Fay, it acquired a half-acre more in the same block (4, 5, 7). This land sufficed for all purposes of the Laboratory until 1902. Then the time appeared to be ripe to plan for a larger, more independent future. As a first step, Dr. John C. Phillips, of Boston (trustee, 1902–19), presented the Laboratory with its first harbor frontage (21, 24)—a strip, 200 feet long, immediately east of the land of the United States Bureau of Fisheries (23). The Laboratory was thus provided, for the first time,

[1] The numbers in parentheses refer to the plan of central land and buildings of the Marine Biological Laboratory (p. 64); as a rule they designate buildings, but they also identify the location of parcels of land.



PLAN OF CENTRAL LAND AND BUILDINGS OF THE MARINE BIOLOGICAL LABORATORY

NUMERICAL DESIGNATIONS OF BUILDINGS

1. Old Main, 1888
2. Old Main, 1890
3. Old Main, 1892
4. Botany, 1894
5. Old Lecture Hall, 1896
6. Loeb laboratory
7. "Mess" and Homestead
8. Residence
9. Residence
10. Dormitory
11. Residence
12. Apartment house
13. Residence
14. Residence
15. Residence
16. Residence
17. Residence
18. Library addition, 1941–42
19. Main laboratory, 1924
20. Crane laboratory, 1914
21. Pumphouse, 1924
22. M.B.L. Clubhouse
23. Location of the United States Bureau of Fisheries
24. Sun dial
25. Supply department
26. Candle house, 1836
27. Carpenter shop
28. Oceanographic Institution, 1930
29. Garage
30. Spindle land
31. Drawbridge

with its own independent access to the salt water. In 1911 Mr. Crane added an adjoining harbor frontage of about the same amount, previously the land and premises of the Woods Hole Yacht Club (22). This land, separated from the main laboratory by only a street, was in the best location for its purposes. In 1917 Mr. Crane also purchased and presented to the Laboratory the historic Bar Neck Wharf (28, 29), on which vessels had been built and whaling operations conducted a century previously (p. 7); about an acre and a quarter in extent and adjoining the previously acquired harbor frontage, it was potentially the most valuable property on the Great Harbor for scientific purposes. Subsequently (1929), about two-thirds of this property was transferred to the Woods Hole Oceanographic Institution (28) as a site for its buildings and wharf. In 1936 another piece of harbor frontage (30), containing 24,000 square feet and immediately adjoining the Bar Neck Wharf on the east, was transferred to the Laboratory for a nominal consideration by Mr. Crane. As a result, most of the north side of the harbor frontage, including the land of the Bureau of Fisheries, was secured for scientific purposes.

During the same time, additional land was acquired adjacent to the original holding, largely as gifts from Mr. Crane. In 1903 the picturesque old stone "candle house," dating from whale-fishing days, with over half an acre of ground (26) and extending from the main street to the salt-water Eel Pond back of the harbor, was acquired; and in 1909 an acre and a half to the west (18, 19, 20), opposite the old laboratory buildings and also bordering on the Eel Pond, was added as site for more permanent buildings. To the east of the "candle house," another piece, of 18,000 square feet, was added in 1915 (27). From time to time, all holdings in the original block were purchased as they came into the market, and, in addition, other separate pieces in the block adjoining on the north, now occupied by two fireproof residence and dormitory buildings.

Most of the land around Woods Hole was held in large estates, and the little that was available in the village itself for sale to members and investigators who wished to establish summer homes was held at prohibitive prices. This condition was hampering the development of the Laboratory; accordingly, search was begun for a considerable tract that might be purchased and subdivided for sale to members. The Fay estate held a tract immediately adjoining the settled part of the village; and the owners, who had shown much friendliness to the Laboratory, especially in its earliest days, consented to sell, on very

THE CANDLE HOUSE IN 1915

Number 26 on the plan on page 64. Erected in 1836

easy terms, 21 acres of beautifully wooded, hilly land, with right of access and of the use of a fine beach on Buzzards Bay. This tract was accordingly bought in 1916; roads were laid out; and the land was divided into sixty-five lots, which were sold to members with proviso for the preservation of trees and the right of first option to the Laboratory on any resale. Practically all the lots have been sold to members, and many homes have been built on this "Gansett Tract." To keep a similar condition from arising again, the "Devil's Lane Tract," of 105 acres about a mile from the Laboratory, was acquired in 1925. The adjacent "Cedar Swamp," of 10 acres, was purchased in 1937 for preservation of its primitive condition and for its ecological interest.

The acquisition of the Devil's Lane Tract in 1925 was also motivated by the consideration that the establishment of institutes representing the physical and chemical sciences might, at some time, be desirable at Woods Hole, not only on account of the already existing close connections of certain aspects of these sciences with biology, but also because the form of organization of the Marine Biological Laboratory constituted a direct appeal to many of their representatives. Such institutes might maintain a relation merely of affiliation with the Marine Biological Laboratory and with one another. They would serve to round out the scientific advantages of Woods Hole and would help to unify the fundamental analytic sciences, not only in their theoretical, but also in their practical or applied aspects. The three sciences of physics, chemistry, and biology are interrelated down as well as up the scale; and the association of representatives during summer months would serve to develop these interrelations—great already in results but of still greater promise. In a practical way, such development would affect medical and industrial research. Unfortunately, the global war dims the outlook; and we cannot see as clearly, as once we thought we could, what the future may have in store.

For recreational facilities a bathing beach on Buzzards Bay within a quarter of a mile of the laboratories was presented by Dr. Edward S. Meigs in 1936. It contains over 35,000 square feet, with a frontage of 231 feet on the bay; for many years previously it had been available for bathing through the kindness of the Fay family. An additional adjoining frontage of 64 feet, held for many years by Dr. Oliver S. Strong for use of members, was presented to the Laboratory by Dr. Strong and other friends in 1940. Tennis courts in the same locality, operated by the Tennis Club, are also held in the name of the Laboratory.

II. Building (Refer to Plan and Airplane View [pp. 64 and 69])

Up to 1913 the scientific work of the Laboratory was carried on entirely in the old wooden buildings (1, 2, 3, 4, 5) completed in 1896, with the exception of a few places provided in the stone "candle house" after 1903 and in a small residence, which was ill-adapted for research. The risk of fire was constantly present; the buildings were subject to vibration, often detrimental to microscopical observations and other work requiring fine adjustments; space for each investigator was cramped; and the total accommodations were inadequate. These conditions had been felt since the turn of the century and constituted a part of the reasons for the plans of reorganization that were under way in 1901 and 1902. Thereafter the improvement of conditions of work, with provision for a stable, fireproof, modern laboratory, were never out of mind; and much study was given to the subject. A committee was appointed in December, 1909, to make a careful study and to prepare plans. In 1912 Mr. Crane agreed to furnish the money, and in 1913 the Crane laboratory (20) was erected and equipped at a cost of $111,000.

It is of simple exterior construction of tapestry brick, with three stories and a high basement (p. 70), facing south on the harbor and across Vineyard Sound to the island of Martha's Vineyard, 4 miles away. The foundations, walls, and 12-inch-thick cement floors insure stability. Into its interior design and equipment went the best thought of many experienced investigators from numerous institutions, so that it has ever since been regarded as an ideal laboratory. The assistant director, Dr. Gilman A. Drew, supervised the work throughout and designed salt-water tables of cement and convenient knockdown aquaria that have been models for other laboratories; and the architect, Charles A. Coolidge, who, as trustee, rendered his services free, co-operated willingly to secure a harmonious spirit and result. In 1924 the Crane laboratory was built into the main laboratory (19), of which it now forms a wing.

In connection with the Crane laboratory, a pumping station for salt water was constructed, with an intake in deep water at the end of a long wharf (21). Rubber-lined, electrically driven centrifugal pumps were installed; and the whole piping system, including specially hardened valves, was made of lead with hard-rubber outlets to avoid the copper contamination, injurious to delicate marine forms, previous-

Courtesy of Howard M. Wood, New Bedford, Massachusetts

CLOSE-UP AERIAL VIEW OF THE BUILDINGS OF THE MARINE BIOLOGICAL LABORATORY AND OF THE WOODS HOLE OCEANOGRAPHIC INSTITUTION, WITH THE "ATLANTIS" AT HER DOCK

For identification of buildings, see plan on page 64

THE CRANE LABORATORY, ERECTED IN 1913

Architect: Charles A. Coolidge

ly caused by the use of brass cylinders and valves. This installation operated so successfully that it became a major problem to prevent the clogging of pipes by marine growths inside them. Special laboratories for physiology and biochemistry were included. Extensive service rooms, including a laboratory, were constructed in the basement. Last, but not least, a large library room was provided on the second floor, facing the harbor, to insure the safety and convenience of use of the books. The entire building was intended for the use of investigators.

The dedication of the new building, held on July 10, 1914, was attended by representatives of many universities, members of the staff, the investigators and students working at the Laboratory, and many friends. The buildings were open to inspection in the morning; demonstrations of sea animals and of research in progress was made; and the Laboratory steamer made a collecting trip. Luncheon was served to the invited guests. The formal exercises were held at two o'clock in a tent erected for the occasion, with an attendance of about eight hundred. The addresses were interspersed with music by the Russian Balalaika Orchestra.

Mr. C. R. Crane, president of the Board of Trustees and donor of the building, presided. In opening the exercises, he said:

> I think we have come here particularly to celebrate the wonderful spirit that is back of the Woods Hole Biological Laboratory. It is very difficult to define that spirit, but I think we all know something of it and something is also known all through the scientific world. Without that spirit no amount of bricks and mortar and organization would be of any great service, but with that spirit the laboratory has been able to accomplish a very great deal with very simple means.
>
> For some time back it has seemed to be worth while to give this spirit a more substantial body. This spirit, as I see it, is very much like the spirit that President Wilson speaks so much of, the spirit of freedom and of co-operation, the fundamental spirit of democracy. In giving this spirit a more substantial body, we have been very fortunate in having with us Dr. Drew. I think we are all very happy at the wonderful result of his year's work. There is a rumor in circulation around here that Dr. Drew is a zoölogist. I believe that rumor has spread into the outside world, but I am very certain that we must all feel, after looking over the new laboratory, that Dr. Drew would have made his reputation as an engineer if he had a chance.

Short speeches were made by the director (IV, 2), by Professor E. G. Conklin, by the head of the United States Bureau of Fisheries, the Hon. Hugh W. Smith (IV, 2), and by Dr. C. S. Minot, of Harvard Medical School. Dr. R. M. Woodward, the president of the Carnegie Institution of Washington, then delivered the main address, on "The Needs of Research" (IV, 4).

The great war which followed soon after caused some depression in the work of the Laboratory, most pronounced in 1918. In the report for that year the director wrote:

> The Laboratory has come through a period of serious uncertainty without harm. Now that this period of suspense is over, we are confronted with an opportunity for scientific usefulness greater by all that has been lost by Europe, and by the spirit of heightened scientific activity that has been aroused in America during the stirring times of war. It is perhaps not so much an opportunity as a duty to see that American institutions of learning compensate the world to some extent for what has been lost. In our field of work this duty and this opportunity are ours.

The rebound from the depression caused by the war carried the attendance in 1919 beyond the previous high-water mark; accommodations in all departments were inadequate, and it was necessary to refuse a considerable number of applications for admission. On the research side, the situation was especially serious. The effort to accommodate all well-qualified investigators resulted in undue crowding. Many of them had to be accommodated in the old wooden buildings, which were becoming increasingly ill-adapted to the advancing requirements of biological research. Another large, modern laboratory had become a necessity.

In 1919 the Board of Trustees decided that it was time to make plans for construction and endowment that would be adequate to meet the requirements of the present generation of biologists. The needs to be provided for included biochemistry and biophysics and more general biological subjects, great expansion of the library, a large auditorium, administrative offices, and technical services; with this, endowment was also to be secured. The undertaking was an ambitious one, but already the influence of the Laboratory had extended to all the principal universities and colleges of the country and into the more advanced medical centers and the newly organized National Research Council. An earnest effort was certain to receive the strongest kind of scientific support.

Committees of the Woods Hole workers were organized, each expert in some phase of the list of needs, as to both construction and equipment, to study their respective requirements. The architect, Mr. Charles A. Coolidge, worked with them constantly; and by degrees the plans took shape, and estimates, both for construction and for endowment sufficient to balance the budget for the enlarged operations, were prepared.

The chairman of the Division of Biology and Agriculture of the National Research Council, Dr. C. E. McClung, of the University of Pennsylvania, was a trustee of the Laboratory and one of its most devoted supporters. At the time of the organization of the Division in 1919, the needs of the Marine Biological Laboratory for additional support were presented by the director; and a committee of the Division was appointed which investigated the situation and recommended that the National Research Council lend its aid in securing funds for the erection of a new building and for extension of the library. The report was considered by the Executive Committee of the Division and was passed on, with its approval and indorsement, to the Executive Board of the Council, which functions for the whole organization. The report was then thoroughly considered and heartily approved by the Executive Board. Dr. McClung and the chairman of the Council, Dr. Vernon L. Kellogg, a member of the Executive Committee of the Rockefeller Foundation, facilitated access to the officers of the latter institution. The president of the Foundation at the time was Dr. George E. Vincent, formerly a colleague of the director at the University of Chicago. Dr. Vincent became officially, as well as personally, interested, visited the Laboratory in the summer of 1921, examined the entire plant and its operation, and expressed the very unofficial opinion: "I would certainly like to see what the *professors* can do!" The Carnegie Corporation was also approached, and Mr. Crane stood ready to endow his annual contribution, through the Friendship Fund, of $20,000 a year when the other negotiations had proceeded far enough.

The estimates had now approached $750,000 for the building; and the endowment needed was estimated at $500,000, in addition to Mr. Crane's endowment. In January, 1922, the Board of Trustees of the Rockefeller Foundation voted to authorize negotiations with the Marine Biological Laboratory on the basis of one-half of a total sum of $1,000,000 for completing the laboratory, library, and auditorium building and providing endowment for its maintenance. This was conditioned upon the total sum being raised, the continuance of the sum of $20,000 annually from the Friendship Fund, and the making of satisfactory arrangements for reversion of endowment in case the work of the Laboratory were to be radically changed or abandoned (p. 83). In February the trustees of the Carnegie Corporation appropriated the sum of $100,000 to the Marine Biological Laboratory "for the purpose of creating a fund, the income of which shall be used

for the maintenance of its buildings and laboratories, provided gifts to the total amount of $1,000,000 be secured for the joint purpose of providing for buildings and for their maintenance."

In December, 1923, Mr. John D. Rockefeller, Jr., personally contributed $400,000 toward the fund for endowment, thus assuring the other contributions. On the completion of the fund of $1,000,000 for building and endowment, Mr. Crane, through the Friendship Fund, presented bonds of the par value of $405,000, yielding $20,020 a year; he gave also a pledge, through the Friendship Fund, to contribute whatever money was needed, in addition to the pledge of the Rockefeller Foundation of $500,000, for completion of the building and equipment according to the architect's plans and specifications. This ultimately came to over $221,000. Mr. Crane's gifts to the Laboratory, either personal or through the Friendship Fund, which he founded, amounted then to considerably over $1,000,000.

The following letters reflect some of the spirit of friendliness and appreciation of the donors. An equally helpful spirit was shown also by the Rockefeller Foundation and the Carnegie Corporation.

Madison, Wisconsin
December 22, 1923

Dear Mr. Rockefeller

I believe now that all of the motions have been made assuring us a fine Biological Laboratory at Wood's Hole.

I am glad to be associated with you in this important work. It will be putting into material form another one of those inspiring dreams of President Harper's. It is many years ago since he directed my interest to this valuable work which needed a little friendly aid. I already knew the community and after studying it more closely came to the conclusion that it was something more than a Laboratory and had many of the elements of a Biologist's Club. These scientists were struggling and accomplishing marvelous things with most meagre equipment, making many sacrifices. It seemed to me that the precious thing to preserve was the spirit of the organization, a spirit every where recognized although hard to seize or to imitate. So we have been most careful in whatever way we planned to aid, not in any way to jeopardize this spirit, and processes of organization and management have continued as I found them. It is a valuable expression of a democracy of educated high minded men. Sometime on the way to Bar Harbor I hope you will "stop-by" and get a nearer view of the work which you have helped so much but which I fear you know about only indirectly.

With warm Christmas greetings to you, Mrs. Rockefeller and the children, I am

Always Sincerely Yours

Charles R. Crane

26 Broadway,
New York,
January 11, 1924

Dear Mr. Crane:

Although I have been so long in acknowledging your letter of December 22nd, I want you to know how much I appreciate your writing me as you have. It was in no small measure because of your deep interest in and close touch with the Wood's Hole Biological Laboratory that I was led to contribute to it. I am happy to have from you this unqualified endorsement of the work, and to know that you regard it as of the highest value. Be assured that it is a pleasure to help to hold up your hands in this interesting and important enterprise.

Cordially reciprocating your holiday greetings, and with every good wish for the New Year, I am

Very sincerely,

John D. Rockefeller, Jr.

Mr. Charles R. Crane,
Madison, Wis.

The main building was erected in 1924 and was dedicated and occupied the next year. The dedication exercises, held on July 3, 1925, were attended by official representatives of more than one hundred American institutions and learned societies and by about four hundred other persons—members of the Laboratory and invited guests. Cabled or written greetings were received from marine laboratories in England, Norway, Sweden, Denmark, France, and Italy. Mr. Crane, president of the Board of Trustees, presided. In his opening remarks he alluded to the spirit of the Laboratory, which he characterized as its most unique possession, of priceless worth. He then introduced the director of the Laboratory (Frank R. Lillie), and the "oldest inhabitant," as he called himself, Professor E. B. Wilson, of Columbia University, who made brief addresses, followed by Professor E. G. Conklin, of Princeton University, who made the principal address, on "The Changing Face of Man and Nature in Woods Hole" (IV, 3).

As seen from the harbor, the main building and the Crane laboratory, now built into one, present an impressive sight (p. 76). The main entrance (p. 77), facing west, is surmounted by four pillars and an entablature. The pediment above bears a large ornament composed entirely of marine animals. Other marine designs appear with the name of the Marine Biological Laboratory in the frieze below the cornice; and yet others, on the bronze inserts between the second- and third-story windows. North of the main entrance, the building is de-

THE MAIN LABORATORY, ERECTED 1924, INCLUDING THE CRANE LABORATORY, AS SEEN FROM THE HARBOR

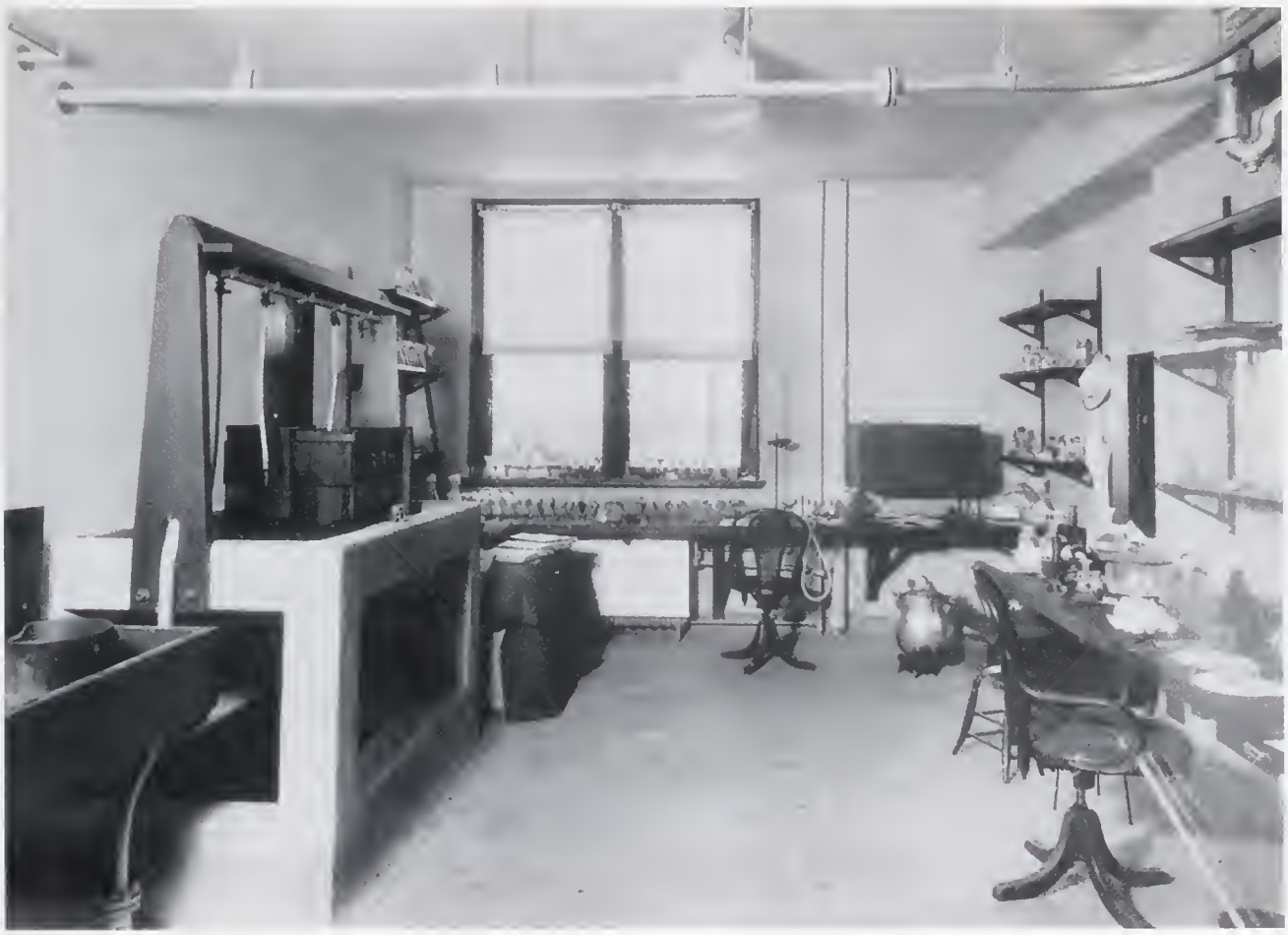
Architect: Charles A. Coolidge, of Coolidge and Shattuck, Boston, Massachusetts

DETAIL OF THE WEST ENTRANCE OF THE MAIN LABORATORY

voted mainly to administration rooms and the library, with some study rooms and an X-ray laboratory on the third floor. In the interior angle of the south and west wings there is an auditorium, seating 550 persons, with its entrance from the main lobby on the first floor.

The remainder of the space is devoted entirely to scientific purposes. Service departments, including extensive chemical, glassware, and apparatus rooms and a very serviceable machine shop, in addition to general storage, are in the basement; and the scientific laboratories are on the first, second, and third floors. Including the Crane building, there are six large laboratories—three for general biological and three for biochemical and biophysical work; each of these has a number of working places, used, for the most part, by investigators under instruction. Other general-purpose rooms are darkrooms for photography and experimental work and X-ray rooms. The remainder of the building is divided into individual research rooms, eighty-three in number, about 10×24 feet on the average, of which fifteen are equipped for biochemistry. These rooms provide ample space for assistants or even for two investigators. One of them, equipped primarily for biological work, is shown on page 79; it includes a salt-water table and all the usual laboratory facilities. The biochemical laboratories, of the same dimensions, are equipped with chemical desks and hoods in addition. Six of the rooms situated above the library are study rooms without salt or fresh water. The old wooden buildings furnish less ample accommodations for fifty-three workers in individual laboratories, in addition to the laboratories for students under instruction.

After the completion of this building, attendance rose again very rapidly; and the need of housing accommodations for those who had not acquired homes of their own in Woods Hole again threatened the natural growth of the Laboratory. The president of the General Education Board, Dr. Wickliffe Rose, who had made himself familiar with the operations of the Laboratory, at first on account of his great interest in the library, saw this situation so clearly that it required no persuasion to induce him to present it to his board. But, first, studies had to be made of the extent and nature of the need. These resulted in a recommendation for two buildings, somewhat differently planned. The first was a "dormitory," designed especially for unmarried students but with some provision for small families; the second was an apartment house for families of various sizes, but also containing some single rooms. The buildings, designed by the architects of the Labora-



A PRIVATE RESEARCH ROOM IN THE MAIN BUILDING

tory, are of brick construction, fireproof throughout, modern in appointments and furnishings, with provision in the apartment house for winter heating. The cost was estimated at $250,000, and this sum was appropriated by the General Education Board in May, 1926. The buildings were ready for occupancy in 1927.

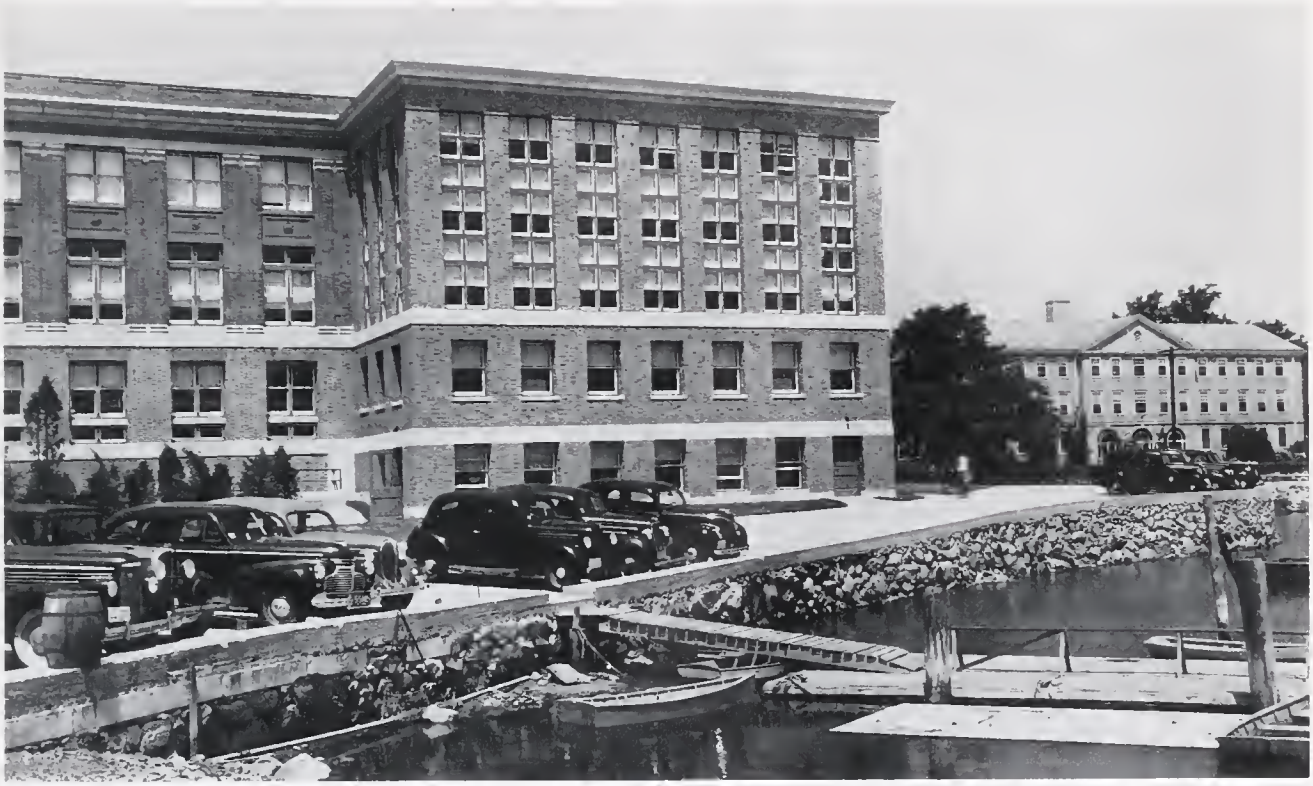
The director, Dr. M. H. Jacobs, described them as follows in his report for 1927:

> The new buildings fill admirably the long-felt need of the Laboratory for suitable accommodations for investigators with families. Together they provide six large apartments, fully equipped for housekeeping, each consisting of a living-room, two bedrooms, screened porch, kitchenette, and bath; two smaller apartments of similar character but with only one bed-room and without a porch; nine suites of two rooms with bath; sixteen double rooms which can be combined in various ways into suites; nineteen other double rooms and eighteen single rooms. Each of the rooms which is not part of a suite containing a bath is provided with hot and cold running water. For the use of those persons who do not occupy the furnished apartments there is provided in each of the buildings a large and comfortable social room and in the basement facilities for laundry work and simple cooking. An especially valuable feature of the Apartment House is that it can be heated, thus making it possible for the working season of the Laboratory to be extended into the colder months of the year.

One hundred and seventy-five persons, including thirty-eight children of families of investigators, were accommodated during the first year.

The old wooden laboratories are still in use for instruction and also to provide for the overflow of investigators impossible to accommodate in the newer laboratories. The number of students admitted to courses has been strictly limited since 1919; but no such restrictions were ever placed upon the attendance of qualified investigators, which has continued to rise very sharply since that time. It does not, therefore, seem possible to dispense with the use of these outmoded structures except by providing a modernized equivalent. This matter is under consideration, together with the question as to how far it is desirable to permit growth to continue.

The growth of the library and its increasing usefulness have, however, demanded attention (see Chap. V). Accordingly, an addition was built in the winter of 1941–42 at a cost of $110,000, provided by the Rockefeller Foundation—an addition which will accommodate 100,000 additional volumes, together with more ample provision for study among the books (p. 81). A condition attached to this gift was shortly afterward met by a grant of $25,000 from the Carnegie Corporation for library development (p. 103).



LIBRARY ADDITION, ERECTED 1941–42, SEEN FROM THE EEL POND; DORMITORY ON THE RIGHT

Architects: Coolidge, Bulfinch, Shepley and Adams, Boston, Massachusetts

III. Balancing the Budget

Up to 1925 the operation of the Laboratory had required gifts to supplement the earned income. In the early days donations came from many friends in small amounts. From 1902 to 1905 the Carnegie Institution aided, as already described (p. 59). After this a small number of friends aided, but the burden was gradually assumed almost entirely by Mr. C. R. Crane, president of the corporation, whose gifts for this purpose alone, either personal or through the Friendship Fund, rose to $20,000 a year from 1916 to 1923, thereafter covered by a gift for endowment from the fund.

Earned income has been multiplied many times, from a few hundred dollars at the beginning to $130,000 in 1940 (IV, A, 2). The sources are various: Fees for instruction, which amounted to $9,760 in 1940, have been an item of income at all times; in the early days they were the main support of the budget, but at the present time, when instruction is maintained purely as a matter of policy, income and expense of instruction are made to balance each other. Subscribing institutions furnished $12,000 in 1940 for research, and investigators $3,000 more. The supply department brought in $32,000; the "Mess," $24,000; the dormitories, $13,000; annual dues of members and receipts from the *Biological Bulletin*, $9,600; the actual expenses almost balance in each case or yield some net income, so that these activities are self-supporting. Income of $26,100 net was also received by the Laboratory in 1940 from businesses in which it has an interest and from rents of minor property. In addition, there is a small amount of miscellaneous income. These earnings are all under the direct control of the Laboratory. But endowment income is necessary to balance the budget.

The income from endowments held in trust amounted in 1940 to a little over $44,000, from securities of about $1,100,000 book value; an excess of $8,000 of income over expense after reserve for depreciation was carried to current surplus. The source of $900,000 of endowment assets has been stated already (pp. 73–74). In 1929 the General Educational Board added $200,000 to the endowment fund for special uses of the library, which replaced annual subventions that they had made for several years for its rapid development. The Library Endowment Fund was placed in the hands of the same trustees who have charge of the General Endowment Fund.

In summary, the following activities are self-supporting or yield an excess of income: the "Mess"; the supply department; rents, including

dormitories; instruction; and the *Biological Bulletin*. The income from endowment and other capital sources suffices to carry the expenses of research, of maintenance and expansion of the library, of general maintenance of buildings and grounds, of administration, and of sundry expenses. These expenses are chargeable back to departments as overhead of the entire institution, with the exception of research (partly self-supporting) and the library, which represent main aims of the Laboratory. Surpluses from all sources have gone largely into purchase of real estate.

The handling of the endowment funds presented an unusual situation. The trustees of the Laboratory, as scientific men, were not accustomed to problems of investment and were naturally afraid of such responsibilities. On the other hand, to place endowment in the hands of a separate Board of Trustees was an unwelcome alternative for a variety of reasons. The director, treasurer, and the president of the Rockefeller Foundation thereupon worked out a plan that in certain respects was new in the annals of educational financing but had been considered and approved in principle by the trustees of the Laboratory in 1921, early in the campaign. It was to the general effect that any endowment established in connection with the undertaking should be held in trust for the benefit of the Laboratory by a competent trust company, but subject to a special provision contained in Article 3 of the deed of trust (IV, A, 1).

Under the provisions of Article 3 a "Committee of Review" was to be constituted, to be nominated, one each, by the following nine organizations: the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, Harvard University, Columbia University, the University of Chicago, Princeton University, Yale University, and the University of Pennsylvania. The university nominations were to be made in each institution by a majority vote of the professors of the departments in the field of biology. It is the duty of the trustee of the endowment funds to call a meeting of the committee once every ten years, to make a study of the work of the Marine Biological Laboratory and to report to the trustee. The intent of this provision was to insure permanently the use of the endowment fund for the promotion of biological research in accordance with the views of representatives of science, especially of the biological sciences. The powers of the committee, while broad, are carefully restricted and constitute an additional guaranty for high standards and for national interest and co-operation.

The land, buildings, library, and equipment represented expenditures of about $1,980,000 up to 1941. The major and minor endowment funds amount to about $1,125,000; the value of the interests of the Laboratory in a biological supply house and a public garage on a very conservative capitalization of income amounts to at least $280,000. The total resources are thus $3,385,000, and there is no indebtedness (IV, A, 2).

The gifts of the great benefactors tend to overshadow the contributions of others to the material growth of the Laboratory; but, if we reckon the spirit of the givers, the merits are equal. The reports of the first ten years contain long lists of persons who, by gifts, testified to their faith in the infant and set it firmly on its feet; and, since that time, there have always been many others ready with gifts of money or service to aid in general or special needs. These, by faith and sacrifice, created the confidence on which the material development was based. The annual reports record numerous instances, but it is the unrecorded spirit on which the past has depended and on which the future hangs.

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CHAPTER V

Policies, Organization, and Administration

I. Policies and Organization

THE Laboratory started with a few simple ideas and policies, which are related in Chapter III. Those that originated with the first Board of Trustees were: the foundation of a permanent biological station on the seacoast, the combination of research and instruction in its activities, and the development of a nation-wide interest in its use and support. Professor Whitman, as first director, accepted these policies as his own; and under his leadership they expanded into those that have governed the Laboratory to the present day. In his report for the year 1895 he comments upon them as follows:

> Here we see sketched the elemental basis of our germ-organization—mainly potentialities of a theoretical character, but "instinct with spirit." The *aim* was a permanent biological station; the *function* was to be instruction and investigation; the *formative principle* relied upon was co-operation [III, 14].

How Whitman interpreted the fundamental policies is set forth in the quotations from his writings given in Chapter III (pp. 37–39).

1. Instruction[1]

Whitman regarded research and instruction as co-ordinate functions with a single aim, not as separate activities under one roof. In an institution like the Marine Biological Laboratory, in which teaching is confined to the summer and is conducted by instructors from other institutions, courses can be made self-supporting by the incentive of opportunities for research offered to instructors added to modest stipends; but the attempt to make instruction a source of financial support for general operations was early demonstrated to be a mistaken policy.

For the first four years, income and expense of instruction nearly balanced. Then for a period of four or five years, under conditions of financial stress, it was demonstrated that fees from instruction could be

[1] See Chap. VI regarding research.

made to contribute to other expenses of the Laboratory to a considerable extent; but the experiment was so threatening to standards and aims and so injurious to morale that the attempt to make instruction a source of general income has never since been repeated. The argument for maintenance of instruction in an institution devoted primarily to research has continued to rest, in the main, upon the considerations adduced by Professor Whitman (pp. 37–38).

There is a large body of students in the country enthusiastic about biology and eager to make a firsthand acquaintance with marine life; on the other hand, there are their instructors, many of whom are anxious to carry on their investigations in the summer under conditions furnished by the Laboratory but who are often without means to do so. The Laboratory brings them together in Woods Hole. It is the aim of the administration to secure as instructors competent investigators from different institutions and to afford them time and facilities, outside of the teaching requirements, which, in any case, occupy only a part of the summer, to carry on their researches. The stipends are about enough for living expenses, and the extra compensation is free use of research facilities and the other advantages of the Laboratory. The staff of instruction constitutes an important part of the whole body of investigators, and their experiences in Woods Hole have often aided greatly in their scientific careers.

Since instruction is not a source of general income, the Laboratory has been free to organize it with reference to the main issue of helping the universities and colleges to produce the biological investigators of the future. Looking to this end, conditions of admission to the courses of instruction have been held high. They are based not on any system of examination on the part of the Laboratory but on written recommendations of their instructors and other biologists. Preference for admission to courses is given to students whose promise or declared intention indicates a professional career in the field of biology. The Laboratory assigns no grades in courses, sets no examinations, and does not certify to attainments in any course; but instructors, as individuals, are at liberty to do so on their own responsibility. The number of students admitted in each course has been strictly limited since 1902 and has not been altered since 1919.

Each applicant for admission to a course fills in a form which provides for the following information: (1) name in full; (2) course desired, subject to requirements stated in the annual announcement; (3) date and place of birth; (4) address; (5) sex, race, nationality,

citizenship; (6) institution represented; (7) if an undergraduate, the year in which a college degree is expected, with experience as assistant, if any; (8) if a graduate, college or university degrees, with dates and names of institutions, position (if any), and status as graduate student; (9) undergraduate and graduate courses in chemistry, physics, and biology, and where taken; (10) list of publications and research in progress; and (11) a statement of reasons for wishing to take the course and of its place in the applicant's professional intention.

A detachable sheet bearing the following statement is to be filled out by the student's instructor or indorser:

> The purpose of the Marine Biological Laboratory in offering courses is to aid in the production and training of investigators; it is the intention, therefore, to give first consideration to persons who appear likely by their intellectual gifts and intentions to contribute to the advancement of science whether in biology in the stricter sense, or in medicine, or in any field in which professional biological qualification is an important factor. The status of the applicant, whether as undergraduate or graduate, may thus be of secondary importance, but other things being equal, preference will naturally be given to the better prepared student.

The instructor or indorser of the applicant is also asked to state: (1) the name and address of the applicant; (2) if more than one student is being recommended for admission to courses from his institution, the order in which acceptance is recommended; (3) whether the fee is to be paid by the institution represented or by the student; and (4) reasons for believing that the student possesses promise as an investigator.

The courses are intended to be contributory to research and are based upon the advantages of marine material, so that they are in no sense duplications of courses that may equally well be offered by universities. Four courses have proved their value through about fifty years: (1) invertebrate zoölogy, established in 1888; (2) marine botany, established in 1890; (3) general physiology, established in 1892; (4) embryology, established in 1893. Marine material furnishes the basis of all these courses, each of which requires the full time of students for a period of about six weeks, with study often extending into the nights. Each student is assigned a private desk, which may be occupied at any time. Naturally, the courses have been kept abreast of advancement in their fields and have been modified somewhat by successive instructors, but in their essential conceptions they have remained the same.

The course in invertebrate zoölogy is designed to introduce students having previous training in zoölogy to marine animal life, especially of the shores and adjacent waters, with reference to anatomy, classification, habits, and ecological relations. Instead of studying preserved specimens in an inland laboratory, the students are taken to rocky shores, sand and mud flats, wharves, marshes, protected inlets, and to open water, where the dredge and townet may be used. Their own collections are supplemented by the professional collectors of the supply department and are kept alive in running salt-water aquaria in the laboratory. However, most of the students' time is spent in the laboratory at individual working places. Lectures relating to and extending their experiences are given daily by specialists in various groups. The students in this course are, in general, the youngest group in the institution.

The course in embryology is also a permanent feature of the instruction because of the special advantages of marine eggs. Unlike most terrestrial and fresh-water forms, in which eggs are concealed by shells, membranes, or the body of the mother and in which early stages, such as fertilization, cleavage, and gastrulation, cannot be well studied in the living condition, the eggs of many marine animals are shed directly into the sea water, where they are fertilized and develop. With the microscope the fascinating life-histories of many species can be studied in the living condition from the beginning. Some of these eggs are glasslike in transparency. They are available in countless numbers; direct observation is easily supplemented by experiments, for the medium, sea water, can be controlled as to concentration and composition of its salts, hydrogen-ion concentration (pH), temperature, etc.; and operations on the egg are performed without difficulty. This course also supplements without duplicating university courses. The students taking this course are more advanced than are the "Invertebrates."

The course in general physiology was the first of its kind, not only in America but in the world. It was a prime factor in the rapid development of the subject in the universities. Marine material offers very special advantages for the fundamental problems with which it deals, such as artificial parthenogenesis, properties of cell membranes, cellular respiration, microdissection of cells, and many other subjects. The students in this course are still more advanced generally in a professional career—usually on the verge of independent research or actually engaged in it.

These three courses are on the zoölogical side. Marine plants offer

THE "INVERTEBRATES," 1895, SETTING OUT FOR A COLLECTING EXPEDITION ON THE SWORDFISHING SCHOONER "VIGILANT"

The steam launch "Sagitta" always accompanied these expeditions, taking additional members of the class and towing the "Vigilant" when the weather was calm or the winds adverse.

THE FIRST EMBRYOLOGY CLASS, 1893

Center: Dr. Whitman; *on his right:* Charles Wright Dodge, Gary N. Calkins, Ira Van Gieson, F. R. Lillie; *on his left:* Fred J. Brockway, M.D., Franklin S. Conant, Harrison G. Dyar (?), William C. Poteat, Edwin T. Brewster, Warren H. Everett, William H. Dudley, Nathan R. Harrington (?).

Seated (*left to right*): S. Emma Keith, Elizabeth E. Bickford, Bertha M. Brown, Marie L. Minor.

a narrower field of interest to the botanist than do marine animals to the zoölogist, because so much more of plant evolution has taken place on land. But the algae, or seaweeds, are subjects of perennial interest; and marine botany has been a permanent division of the work of the Marine Biological Laboratory. The course includes field trips, laboratory work, and lectures, as in the course in invertebrate zoölogy, and it always attracts a select body of students. The work is important on the physiological side as well as for morphology and taxonomy.

The courses just enumerated have been permanent features of the work of instruction at the Marine Biological Laboratory. From time to time, other courses have been started and dropped. By far the most important of those was the course in protozoölogy started in 1919 by Professor Gary N. Calkins. It was maintained as an inspiring course as long as he was able to conduct it; but on his retirement, twenty years later, it was dropped because, as the subject had developed, the marine location did not appear to offer sufficient advantages over university laboratories to justify its continuation.

The staff of instructors in the various courses is drawn from many universities and colleges, so that the Laboratory has the advantage of drawing on the experience of many American institutions in biological teaching. Since the four principal courses have been in continuous operation for fifty years, each has its own traditions and interesting history, to which an entire chapter might be devoted. The head of each course usually serves for several years; and changes in his staff overlap, so as to preserve continuity of personnel and of experience with the special materials of each course.

The student body proper is capped by a large group of investigators "under instruction"—for the most part, graduate students from various universities beginning their first pieces of investigation, usually under their own professors, also working in Woods Hole, or with the aid of a staff of investigation and consultants belonging to the four main departments. Their work is, of course, entirely individual.

Instruction thus ties up directly with investigation in mutually helpful relations. There are many rather intangible evidences that the courses at the Marine Biological Laboratory have been an important factor in the careers of many American biologists, owing to the nature of the courses themselves and to other stimulating contacts at Woods Hole. More tangible evidence is the large number of former students who appear later in the Laboratory as independent investigators. The number of former students who have established themselves in biology

in a professional way is perhaps the most convincing test; this may be determined by the fact that many of their names are included in *American Men of Science*.[2] Allowing a period of ten years for attainment of this degree of recognition, it was found that between 1918 and 1931, inclusive, out of 1,720 total registrations, 51.3 per cent of the men and 14.3 per cent of the women were included. The percentage of the men in the various courses so included was: in invertebrate zoölogy, 47 per cent; in embryology, 46 per cent; in physiology, 55.6 per cent; in protozoölogy, 57 per cent; and in botany, 42 per cent. This takes no account of the large number who have gone into medicine. These figures have considerable significance, but they by no means measure the full influence of instruction in the life of the Laboratory or on the development of biology in America. The trustees have recently reaffirmed the policy that instruction and research should continue to be companion principles in the Laboratory.[3]

2. Representation and Co-operation of Institutions

The unique advantages for important parts of training in general biology at Woods Hole, as well as the opportunities for research, have made a strong appeal to students and investigators throughout the country. When first founded, the Marine Biological Laboratory stood alone; since then, stations with similar aims have been established at several points on the Atlantic and also on the Pacific Coast, but the Marine Biological Laboratory is the only one in America that has consistently maintained a truly national standing through its co-operative organization and freedom from dependence on any single institution. The secret of its larger growth depends on these policies (pp. 37 and 85) and on the men and institutions supporting them.

During the course of the years to 1941, 999 institutions were represented by students and investigators at the Marine Biological Laboratory; of these, 813 were in our own country and 156 were foreign institutions. These are tabulated in an appendix (V, A, 1). In the United States, forty-six states and the District of Columbia are represented. For each state the representation of institutions is classified into the following: secondary schools; normal schools and junior colleges; colleges, universities, and foundations; medical schools and hospitals; research institutions, museums, and government bureaus. Foreign institutions are merely divided into those of the Americas, of

[2] *Marine Biological Laboratory, Annual Report, 1939*, p. 27 (III, 14).

[3] *Ibid., 1938*, p. 21.

Europe, and of the remainder of the world. This record is strong testimony to our belief that the Laboratory has exercised a really extraordinary influence on the development of biology, especially in America.

Of the American institutions represented, 519 are from maritime states: 454 from Atlantic seaboard states, 36 from Gulf states, and 23 from the Pacific Coast. But the other states of the Union, 24 in number, are represented by 294 institutions, the largest numbers being from Illinois (59), Ohio (47), Wisconsin (23), Michigan (21), and Indiana (17). Of all the states, New York is represented by the largest number of institutions (140); Massachusetts is next, with 76; and Pennsylvania follows, with 71. It is interesting to note that two of the central states—namely, Illinois and Ohio—are not far behind.

Among the institutions thus represented by the workers, a large number subscribe directly for accommodations for their students or investigators. These are known as "subscribing" or "co-operating" institutions (V, A, 2, and V, A, 3). Among these, certain ones may be designated as "supporting" institutions on account of the regularity of their subscriptions. Four institutions maintained subscriptions for the whole period tabulated, 1892–1941, ever since the principle went into effect—thus, for 49 years; 6 others have maintained subscriptions for 40 years or over; 7 between 30 and 39 years; 20 between 20 and 30 years; 42 between 10 and 20 years; and so on (V, A, 2).

It was originally intended that supporting institutions should enjoy special privileges of appointment of representatives to membership in the corporation (p. 36). But the principle of direct institutional representation has never come into practice, though it was considered again in 1900 in a different form (p. 47). No institution as such has acquired any vested interest in the government of the Laboratory or has, indeed, exhibited any desire to assume the implied responsibility. Instead, a very large number of institutions are represented informally through individual memberships of scientifically qualified members of their faculties in the corporation or on the Board of Trustees.

Supporting institutions usually have continuous occupancy of the same rooms and thus secure permanent facilities for marine work, including supplies, access to one of the finest working biological libraries, and many other advantages, for a fraction of the cost of independent access to marine material alone.

The number of institutions represented increased rapidly from about 15 in 1888 to 85 in 1895 and, with fluctuations, to 165 in 1937, falling

off to 144 in 1941, for obvious reasons. The number of subscribing institutions rose from none at first to 85 in 1927, fell off to 65 during the depression, and rose again to 82 in 1939; the number was 78 in 1941, which carries us up to the start of war. The attendance of investigators and students from 1937 to 1941 is given in the accompanying table. These numbers compare with a total of 16 in 1888.

TABULAR VIEW OF ATTENDANCE AT THE MARINE BIOLOGICAL LABORATORY

	1937	1938	1939	1940	1941
Investigators—total	391	380	352	386	337
Independent	256	246	213	253	197
Under instruction	74	53	60	62	59
Research assistants	61	81	79	71	50
Library readers	.....	.....	.....	.....	31
Students—total	133	132	133	128	131
Zoölogy	57	54	55	55	55
Protozoölogy (not given in 1941)	16	10	12	7	.....
Embryology	35	34	36	34	37
Physiology	16	22	21	22	24
Botany	9	12	9	10	15
Total attendance	524	512	485	514	468
Less persons registered as both students and investigators	13	16	14	7	7
	511	496	471	507	461
Institutions represented—total	165	151	162	148	144
By investigators	134	125	132	112	102
By students	79	67	72	79	72
Schools and academies represented					
By investigators	3	4	2	1	5
By students	2	1	2	2	2
Foreign institutions represented					
By investigators	16	14	8	2	3
By students	.....	3	1	1	1

3. Members and Trustees of the Corporation

The Marine Biological Laboratory was incorporated in the commonwealth of Massachusetts on March 20, 1888, "for the purpose of establishing a laboratory or station for scientific study and investigation, and a school for instruction in biology and natural history" (III, A, 1). The members of the corporation elect the trustees, the treasurer, and the clerk; the latter become, on election, trustees ex officio. In turn, the trustees establish rules of eligibility and elect the members of the corporation (V, A, 4). The property of the Laboratory is, of course,

vested in the corporation. These simple relations work out admirably for a co-operative institution.

The members.—The early relations of trustees and members has been related in Chapter III. No formal rules of eligibility for membership had then been worked out; but, as time went on, standards of eligibility were gradually raised and were finally formulated by the trustees in 1937 as follows:

> Proposals for membership in the Corporation shall be made to the Nominating Committee on or before the first Tuesday of August upon a regular form and endorsed by two members of the Corporation.
>
> With the recognition that rigid and completely standardized requirements for membership in the Corporation of the Marine Biological Laboratory are neither practicable nor desirable, it is recommended that future members of the Corporation shall, in general, be selected from among persons who, by engaging in active research at the Marine Biological Laboratory during substantial portions of at least two summers, shall have become acquainted with the work, aims, and peculiar problems of the Laboratory, and who, by papers published over a period of several years shall have demonstrated a capacity for sustained scientific productiveness not less than that required for full membership in such national societies as the American Society of Zoölogists, the Botanical Society of America, and the American Physiological Society.
>
> It is further recommended that in doubtful or border-line cases actions on application for membership shall be deferred until a time when, in the opinion of the Nominating Committee then serving, the status of the applicant has become entirely clear [*Minutes of the Board of Trustees, 1937*].

These regulations are gradually establishing the membership of the corporation as a body of highly qualified scientific men and women, 371 in number (1941), representing 132 American institutions of learning from 34 states, including the District of Columbia. Lists are published in the annual reports. The attendance at the annual meeting in Woods Hole on the second Tuesday in August of each year is about 25 per cent of the membership. All members are kept in touch with the institution by receipt of annual announcements, reports, and the *Biological Bulletin*, the official scientific publication of the Laboratory, issued bimonthly. A large number of the members attend the sessions of the Laboratory regularly; and some take direct part in the courses as instructors, members of committees, and in other ways. The membership in so many institutions of education and research reinforces the influence of the trustees in the external relations of the Laboratory.

The trustees.—The trustees consist of 32 regular members, 4 ex officio members, and 11 emeritus members (1940) who do not vote (V, A, 4,

and A, 5). The regular members are divided into four classes of 8, each to serve 4 years; one class is elected annually by the members. The entire body comes from 21 institutions, extending all the way from New England to California. Trustees are usually re-elected for successive terms; this practice has great advantages from the benefits of long experience and also from the continuity of interest of strong institutions. Provision for transfer to the emeritus class at the age of seventy has furnished opportunity for the influx of younger members and avoids stagnation in the Board of Trustees.

The corporation has established rules concerning the nomination of trustees for election as follows:

> The Committee of the Corporation for nomination of Trustees shall consist of five members, of whom not less than two shall be non-Trustee members and not less than two shall be Trustee members of the Corporation.
>
> On or about July first of each year, the Clerk shall send a circular letter to each member of the Corporation giving the names of the Nominating Committee and stating that this committee desires suggestions regarding nomination.
>
> The Nominating Committee shall post the list of nominations at least one week in advance of the annual meeting of the Corporation.[4]

The same committee, appointed by the Executive Committee of the Board of Trustees, also makes nominations annually for the treasurer and the clerk of the corporation.

The trustees, like the members, meet regularly but once a year, on the same day as the members. In 1941, 36 out of a total of 47 were present. Routine business is transacted by an Executive Committee, which has the full powers of the Board when not in session except to modify the by-laws of the corporation, to fill vacancies in the Board of Trustees, to change the scientific policies of the institution, or to appoint or remove the director or assistant director. The Executive Committee meets weekly during the summer session. It consists of seven members: the president of the corporation, the director and the treasurer ex officio, and 4 members elected by the trustees, 2 each to serve 2 years. The elections are rotated among trustees resident in Woods Hole in the summer, so that many of them become intimately acquainted with the problems of operating the Laboratory.

It has already been stated that no institution has any vested right in the property or organization of the Laboratory. The influence of the

[4] *Ibid.*, *1931*, p. 14.

TRUSTEES IN ATTENDANCE AT THE ANNUAL MEETING OF 1932

Front row, seated (left to right): E. G. Conklin, T. H. Morgan, W. M. Wheeler, G. H. Parker, Gary N. Calkins, Frank R. Lillie, Walter E. Garrey, L. V. Heilbrunn.

Second row, standing (left to right): M. M. Metcalf, Alfred C. Redfield, C. R. Stockard, Merkel H. Jacobs, M. J. Greenman, H. H. Donaldson, W. B. Scott, Lorande L. Woodruff, H. B. Goodrich, D. H. Tennent, Albert P. Mathews, Franz Schrader, Cornelia M. Clapp.

Back row, standing (left to right): F. P. Knowlton, Robert Chambers, Charles Packard, I. F. Lewis, E. R. Clark, Caswell Grave, Otto C. Glaser, Ralph S. Lillie.

universities and colleges rests entirely on the strength of their faculties and student body. It has been the constant effort of the Laboratory to secure the leading biologists of the country for trustees and a broader selection among those best qualified for membership in the corporation and on the teaching staff. The stronger institutions have naturally a preponderating influence, but all have equal rights and opportunities. The Board of Trustees has always been a body eminent in the biological world, and the steady influence of its members throughout the years has been a factor of incalculable importance in the development of the institution; conversely, the influence of the Laboratory on the status of biological education and research is particularly strong in the institutions to which the trustees belong.

This may be better appreciated by a study of the list of all who have served as trustees up to 1940 (V, A, 6). They are 113 in number, and they come from 50 institutions in 21 states of the Union. Seven of them served from 41 to 49 years, 9 between 30 and 39 years, 20 between 20 and 29 years, and 14 between 15 and 19 years. One institution has had 10 members throughout the years, another 8, another 7, two others 6 each, and so on down. Massachusetts, the home state, has had 30 persons serving as trustees; New York, 23; Pennsylvania, 15; Illinois, 10; Maryland, 7; New Jersey, 5; Connecticut and Ohio, 4 each; Michigan, 3; California, Tennessee, Virginia, the District of Columbia, and Wisconsin, 2 each.

The list also includes the names of lay members who have been influential in the upbuilding of the Laboratory: Edward T. Cabot, of Boston, treasurer from 1890 to 1893; Charles A. Coolidge, architect of Boston, member for 20 years; C. R. Crane, of Chicago, member for 38 years and president of the corporation for 20 years; Florence M. Cushing, of Boston, trustee from 1887 to 1897; D. Blakely Hoar, of Boston, treasurer for 24 years; Camillus G. Kidder, of New York, trustee for 24 years; A. Lawrence Lowell, of Boston, clerk of the corporation for 3 years; Susan Minns, of Boston, trustee for 3 years; L. L. Nunn, of Telluride, Colorado, trustee for 27 years; Anna Phillips Williams, of Boston, clerk and secretary from 1887 to 1897; Lawrason Riggs, of New York, treasurer from 1924 to 1942 and president since 1942; Georgiana W. Smith, of Boston, trustee for 6 years; William S. Stevens, of Boston, treasurer for 2 years; Samuel Wells, of Boston, trustee from 1888 to 1889. All these rendered service to the Laboratory freely, sympathetically, and generously.

II. Administration

1. The Officers (V, A, 7)

The *president* of the corporation is elected by the trustees from among their own number. He is not an executive officer but is chairman of the Board and of its Executive Committee, and he also presides at all meetings of the members of the corporation.

The *treasurer* and the *clerk* of the corporation are elected by the members at their annual meeting, held in the Laboratory on the second Tuesday of August each year. The treasurer is ex officio a member of the Board of Trustees and of the Executive Committee. He keeps the accounts of the Laboratory, with the aid of the business manager; he also advises the trustee of endowment funds in matters of investment. His accounts are audited annually by a certified public accountant. The clerk records the minutes of the meetings of the members of the corporation and keeps the roster of members. He is ex officio a member of the Board of Trustees.

The above officers serve without salary. The other officers are appointed by the trustees or the Executive Committee.

The *director* is the chief executive officer; from 1894 to 1925 there was also an assistant director. Up to 1925 the director served without salary; and part of this time (1901–8) the assistant director, in charge of administrative detail, served also without salary. Later (1925), with the development of the office of the business manager, many of the duties of the assistant director were taken over by that office; and the director, serving now without an assistant director, became a salaried officer on part time until 1942, when a full-time appointment was made.

Among those who have held the office of assistant director, it is not invidious to single out Gilman A. Drew for special mention. He held office from 1909 to 1924, during the period of greatest material growth of the Laboratory; prior to this time, from 1901, he was in charge of the course in invertebrate zoölogy, so that for a period of twenty-four years he was prominent in the work of the Laboratory. It would be difficult to do full justice to the value of his services during the [illegible] years in which he devoted his full time to administration. In the splendid modern buildings of the Marine Biological Laboratory the marks of his minute supervision, ingenuity, and inventiveness are everywhere apparent; he was at once the architect's best collaborator and the investigators' chief reliance in construction and equipment. He intro-

duced the new system of accounting that the larger operations demanded. He enjoyed the confidence of all and the affectionate regard of many members.[5]

The *business manager* operates under the treasurer and director. Since 1913, when the present incumbent, Mr. F. M. MacNaught, was appointed, the position has grown in scope and importance. Under the treasurer he keeps the running accounts of the Laboratory in all departments and prepares the annual budget, with the advice of the director, for consideration by the Executive Committee. Under the director he also serves as registrar and attends to the administration of board and housing and the rentals of Laboratory property. His duties bring him into personal contact with all members of the Laboratory and require all the knowledge, diplomacy, and tact that long experience develops. His chief assistant, Miss Polly L. Crowell, has served the Laboratory for twenty-seven years.

2. The Library

The development of a working library was one of the earliest aims of the founders of the Marine Biological Laboratory, and its upbuilding remained a chief concern at all times. In its isolated position the Laboratory could not rely on any established library except for temporary loans, and research would be impeded unless books were available for reference. As in the case of other departments, the growth of the library proceeded from small beginnings and developed at an accelerating pace. In the selection of books for the library the workers have been regularly and systematically consulted; they knew books and the order of importance of acquisitions, and their advice prevailed. As a consequence, although the library has grown to be one of the finest biological research libraries in the country, it contains very little material of merely fugitive interest.

In the first annual report the trustees expressed their indebtedness to the Boston Society of Natural History and others for aid in connection with the library, and the director emphasized the necessity of having not only standard books of reference but also "as the minimum to begin with all the important journals now printed in the four principal languages." Dr. Whitman's ambition never set near limits, nor yet unattainable ones.

In 1891 Professor J. P. McMurrich, of Clark University, acted as

[5] See biographical sketch, *Science*, 80:470–71. Cf. also Chap. VII.

librarian; in 1892, Dr. E. O. Jordan, then also of Clark University; from 1893 to 1907, Professor Cornelia M. Clapp, of Mount Holyoke College; from 1908 to 1916, Professor H. McE. Knower, of the University of Cincinnati; from 1919 to 1924, Professor R. P. Bigelow, of the Massachusetts Institute of Technology. All these served without compensation, although the duties became increasingly arduous. By 1914 it was necessary to appoint a full-time, paid assistant to the librarian. Mrs. Thomas H. Montgomery, Jr. (Priscilla B.), was appointed assistant librarian in 1919, librarian in 1925, and has been in charge since that date.

At the end of the second year (1889) the library contained 343 bound volumes and 525 unbound pamphlets, and 22 journals were currently received. For the next twenty-five years the books were stored in the original frame buildings, subject to the risk of fire; the librarian served without salary; and available funds were small. All these conditions operated for a slow rate of growth—a growth which was, however, steady. The total number of accessions by this time reached about 4,800, including 3,300 bound volumes, mostly serials, and 1,500 unbound pamphlets. It was a great relief to all when the library was removed, in 1914, to the first fireproof building. It now occupied a beautiful, well-equipped room overlooking the harbor and had an estimated capacity of about 19,000 volumes.

By this time the income of the Laboratory had improved, and it was possible to proceed more seriously with the development of the library. The entire library was reaccessioned and new catalogues made. Under the direction of Dr. Knower a systematic drive was inaugurated for the increase of the library by gifts, exchanges, and purchase. The total accessions rose to about 19,000 by 1919. At that time, Dr. R. P. Bigelow became librarian and Mrs. Montgomery assistant librarian. Their efforts increased the accessions to 23,000 in five years, and the accommodations were overflowing. This condition had been anticipated in the construction of the main building in 1924–25, in which a stack, capable of housing about 80,000 volumes, was included with a large reading-room, cataloguing room, and librarian's office. With greatly increased budget, the Laboratory was ready to proceed after thirty-seven years, with the dreams of the first director fulfilled. The final moving to the new quarters took place in 1925. It was supposed at the time, that it would take from twenty-five to fifty years to grow up to the new accommodations; but less than fifteen years later these accommodations were also outgrown, and an addition, capable of housing

about 100,000[6] additional volumes, was built in 1940 (p. 80). Special study tables have been installed next to windows on three sides of the new stacks, the books have been redistributed, and the whole presents an ample, pleasing, and convenient arrangement.

In 1941 the library contained about 45,000 bound volumes of serials, including 2,366 journals and proceedings of learned societies, most of them in complete sets; about 7,000 books; and about 125,000 reprints. Regularly being received by subscription or exchange were 1,257 journals, a slight decrease from the high-water mark of 1,339 in 1936, attributable to disturbed foreign conditions. Current numbers are filed in a large general reading-room, separate from the stacks. In addition to the librarian, a secretary and two assistants are required for library administration.

The maintenance of so large a library in so remote a location, with its principal use limited to between three and four summer months, has sometimes been criticized. The same criticism has been leveled against the strong fireproof construction and the elaborate equipment of the main buildings. The answer in all cases is the unique service rendered. Specifically with reference to the library: the needs of about three hundred and fifty investigators in their current researches are served during the summer; they represent about one hundred and thirty institutions, in most of which the library resources are far inferior. Thus, an adequate reference library in biology becomes available to all, with the added advantages of the scientific associations and a comfortable and interesting summer environment. This results in a large part of the library work of investigation being done here by many, some of whom devote the major part, or even all, of their time to it. There are very few biological libraries anywhere that render an equal service.

During the first twenty-five years the library depended, for the most part, on many small gifts for its growth. The first gift reported was $100 from Mrs. H. D. Wilmarth, of Boston, in 1888; in 1889 Mrs. Glendower Evans, of Boston, presented $1,000, which was used, with a small addition from general funds, to start the collection of scientific journals. In 1894 a bequest of $500 was set aside as a nucleus of an endowment fund for the library, which grew by small accretions to

[6] Storage capacity is based on seven volumes per running foot of shelves. In the case of serials, two or three numbered volumes are often bound together, so that the total number of volume-accessions is much greater than that of bound volumes. The reprints and pamphlets occupy one entire floor, or one-fourth of the storage space. Duplicates of serials and reprints held for sale or exchange are also stored in the stacks.

about $3,000 by 1924 and was then used for purchase of books, since much larger resources were in sight. During the first twenty years, when the library budget was only a few hundred dollars annually, the members of the Laboratory vied with one another in presenting books, subscriptions to journals, and reprints, which represented collectively a large proportion of the acquisitions.

The growth of the library received an immense impetus after the building of 1924; storage space for at least 80,000 volumes was a challenge. To this the General Education Board responded with a gift of $50,000, to be expended over a period of five years for purchase of books, serial publications not then in the library, and the filling-out of incomplete series. This gift was due to the interest of the president of the Board, Wickliffe Rose, in the development of the Laboratory—an interest which was evidenced further, after the expenditure of the capital fund, by a gift of $200,000 from the General Education Board in 1929 for endowment of the library. The extensions thus begun required supplementation by greater annual appropriations from the general funds and resources of the Laboratory, so that the total expenditures (including exchanges) on the library have ranged around $25,000 a year for the last fifteen years. After the completion of the latest addition to the library wing in 1941 (p. 80), a most generous contribution of $25,000 was received from the Carnegie Corporation for library development; it is proposed to use this gift for the purchase of books and serial publications as soon as war conditions permit importations from abroad.

The library has grown not only by purchases but also by permanent deposits of books by institutions, by gifts from authors and publishers, and by exchanges. In 1913 the American Museum of Natural History in New York deposited about 2,300 volumes of duplicate series as a permanent loan and has continued up to the present time to send the current continuations. When the Woods Hole Oceanographic Institution was established and its buildings erected on land formerly belonging to the Marine Biological Laboratory, it was decided that it would be of great mutual advantage to store and administer the library of the Institution with that of the Laboratory across the street. Accordingly, an original appropriation of $5,000 was made by the Oceanographic Institution for the purchase of oceanographic books and journals; this has been supplemented by an annual appropriation of from $600 to $1,000 and by the publications received by the Oceanographic Institution from exchanges and gifts.

Almost all of the collection of 125,000 reprints in the library has been received by gift. Workers at the Laboratory present their current publications, and they are urged and encouraged to furnish complete sets. A very large number have done so; and, since this practice has extended over many years, the Laboratory possesses the only extant complete collections of reprints of publications of a large number of American biologists, including the most famous names of the period. These, usually bound together in chronological order, are invaluable to scholars studying the work of individual biologists. Regular acquisitions of the reprint collection are added at the rate of 3,000 to 4,000 annually. Some biologists have presented their own reprint collections, and those of others have been donated after death. Among the former, Miss Katherine Foot donated 750 items in 1918; Dr. Ida H. Hyde donated 1,900 items the same year and more in 1927; Dr. M. M. Metcalf donated 9,200 reprints and 277 books over a period of five years, beginning in 1927, the finest gift of books and reprints received up to that time; and in 1942 Dr. H. E. Crampton presented 5,102 reprints on miscellaneous subjects and Dr. Rudolf Höber generously presented his collection of 7,217 reprints in the subjects of physical and physiological chemistry and physiology. In 1925 about 10,000 reprints and books and serials were received from Dr. Whitman's library; in 1927 Charles W. Hargitt's collection of 500 items on Coelenterata was given by his son; and in 1936 Mrs. Drew presented Gilman A. Drew's collection of 7,000 reprints and pamphlets. These are the principal gifts of collections, though there are others, which usually are somewhat specialized according to the collector's interests and would be unobtainable in any other way. One set of any duplicates received is filed in orderly reserve storage, and any additional copies are used for exchange or sale.

The huge collection of reprints is of great service. They are fully catalogued, and any one of them is easily found. They save much wear and tear on the bound volumes of journals. The use of reprints also makes it reasonable to enforce a rule against taking bound volumes to individual research rooms, a privilege which is allowed in the case of reprints. When a bound volume of a journal is in use, it is usually being consulted regarding a single contribution; and all the many other articles that it contains are, for the time, unavailable to anyone else. The reprint collection, arranged by authors and catalogued by subjects, though a supplement only to the journals, is invaluable as a

totally different approach to the literature and as a duplication of the journal material.

Owing to the very representative attendance at the Laboratory, some publishers find it advantageous to present to the Laboratory the books that they issue in its field; these are displayed for the season on the shelves of new books. A number of the larger houses also make annual independent exhibits of their publications of biological books and thus reach many colleges. They also make useful acquaintances among prospective authors. Mutually advantageous relations are thus established, to the benefit of the library.

Another source of accessions to the library is through exchanges. The official scientific journal of the Laboratory, the *Biological Bulletin*, receives 609 serial exchanges for the library; and the scientific publications of the Oceanographic Institution are exchanged for 65 more.

In subject matter the library aims to cover in a comprehensive way all fields of biological science. In addition, it attempts to include those publications in physics, microscopy, chemistry, oceanography, limnology, meteorology, history of science, palaeontology, the biological phases of medicine, and other fields wherever these publications appear important to the primary functions of the library.[7]

Investigators are urged to suggest additions of books and journals, which are secured whenever possible, and in this way the very comprehensive field is constantly checked. Investigators are also allowed free access to the shelves.

The members of the library committee, who meet with the librarian at least once during the year as consultants and final authorities in major decisions, are also available by correspondence in any matter of importance that may arise throughout the year. The close contact maintained with the library, not only on the part of the committee but also by members of the Laboratory and of the corporation and its officers, is largely responsible for the happy situation in which the library stands today.

3. Publications

The "Annual Announcement."—Issued in January each year, this publication contains a list of trustees, of the staff, of standing committees, and of the subscribing and co-operating institutions for the preceding year. The research facilities are described, and the conditions of their use stated. The courses of instruction are described separately,

[7] From the annual announcement of the Marine Biological Laboratory for 1941.

with conditions of admission. Statements concerning the service departments follow. It is a pamphlet of about thirty pages.

The "Annual Reports."—Annual reports on the work and incidents of the preceding year have been published since the foundation of the Laboratory. In addition to statistical material—including the membership of the trustees, Executive Committee, corporation, standing committees, the staffs of all departments, classified lists of all in attendance with institutional address, and subscribing and co-operating institutions—the reports of the director, the treasurer, and the librarian are regularly included. The evening lectures, as well as shorter scientific papers presented in open meetings, are always listed. In addition, there are, from time to time, special features, such as descriptions of new buildings, memorials of deceased trustees or others who have been active in affairs of the Laboratory, and reports of occasional significant events. The collected reports constitute a treasure-house of information on the history of the Laboratory. Since 1907 the annual reports have been published in the *Biological Bulletin*, but they are also distributed in reprint form.

The "Biological Bulletin."[8]—There is no better way to bring the purpose and practice of the *Biological Bulletin* before the readers than to reprint the report that the managing editor, Professor A. C. Redfield, of Harvard University, made in 1940 on the occasion of his retirement from this office, which he filled from 1930 to 1941. This, like other documents important to members of the Marine Biological Laboratory, is printed as an appendix (V, A, 8). As Professor Redfield states, the *Biological Bulletin* is the one tangible return which members of the corporation receive in exchange for their membership fees, whether they return each year to the Laboratory or not. By it they are kept in touch with the operations of the Laboratory in the form of the annual report of the preceding year, printed in the July number of each year, and with much of the scientific activity by the publication of abstracts of the papers delivered at the scientific meetings during the summer. The other important institutional function, as a medium by which the library receives about one-half of its current list of periodicals, has already been mentioned (p. 105; cf. V, A, 8).

But the primary function of the *Bulletin* is the publication of the results of biological research, whether presented by workers at the Laboratory or by other investigators. Founded by Dr. Whitman as a com-

[8] A brief account of its predecessor, the *Zoölogical Bulletin*, is contained in an appendix (V, A, 8).

panion serial to the *Journal of Morphology*, the *Biological Bulletin* was taken over by the Laboratory, beginning with Volume 3, in 1902. Two volumes are issued each year, originally in monthly, but latterly in bi-monthly, numbers. Eighty-five volumes had been published to the end of 1943. Like the Laboratory itself, the *Bulletin* has a national scope which is not in the least overshadowed, but rather enhanced, by its institutional functions. The present managing editor, Dr. H. B. Steinbach, of Washington University, is supported by an editorial board of fifteen members, representing ten universities in the eastern and midwestern states and in California; these members act as referees on research contributions.

The "Collecting Net."—Though not an official publication of the Laboratory, the *Collecting Net* has become a medium of internal communication of great usefulness. It was established by Ware Cattell in 1926. It is issued weekly during the summer sessions and serves to bring together the interests of the three scientific institutions of Woods Hole, and also to a lesser extent those of other summer biological stations of the entire country. It is a kind of weekly scientific newspaper which includes a guide to arrivals and departures and the local addresses of all resident officers and scientific workers, in addition to items of current interest. Programs of meetings are announced by it in advance, and it reports all the numerous lectures and scientific papers presented—at least in abstract and often in complete form—so that its volumes contain much source material of permanent scientific interest. It has a considerable local distribution outside the scientific community. Its entirely unofficial character gives it a degree of freedom advantageous to its purposes.

4. The Supply Department

From the beginning of the Laboratory, provision was made for procuring specimens for the work of instruction. For the first two years only rowboats were available; but the strong tides that prevail in the neighborhood of the Laboratory prevented adventures in collecting far afield, and so a steam launch, later named the "Sagitta," was purchased in the spring of 1890, and John J. Veeder was employed as captain. The 35-foot "Sagitta," purchased at a second-hand cost of $1,350, proved a most excellent boat and served the Laboratory for many years. The collecting area was thus enlarged many times, new collecting grounds were located, and the danger of depleting those near at hand was avoided. At the same time, a greater variety of material

was made available. In 1906 the much larger "Cayadetta" (75 feet over all) replaced the "Sagitta."

In the early days the investigators at the Laboratory did most of their own collecting, with such aid in transportation as the boats could furnish. This had the advantage of familiarizing laboratory workers with the habitats and habits of the animals with which they worked. None of the early workers were like certain of their late successors who, as a result of delivery service on requisition, regarded sea urchins, for instance, as spiny creatures in aquaria that obligingly yielded countless eggs and infinite spermatozoa when demanded. The delivery service of living material, which has reached a high state of perfection, was a necessary consequence of the increase of numbers of workers and specialization; it results in a great saving of time for investigators, but those who need to know animals in their natural environments are accommodated on collecting trips.

The collecting of living material, its storage, and its delivery in healthy condition to investigators and classes is really the most essential service within the Laboratory, for on this material all original study depends. After delivery to the workers, it must still be maintained ready for use as needed; and, therefore, from the time of the foundation of the Laboratory, provision for the circulation of clean sea water to all working places and classrooms was provided. Fortunately, the harbor in front of the Laboratory receives little pollution, and strong tidal currents flow through it continuously, changing direction with the flow and ebb of the tides, preventing stagnation, and constantly renewing the water of the harbor. The water can therefore be pumped directly from the harbor; the necessity of a closed system of circulation, with a stored body of sea water circulating from the tank and back to it again through a filtering and purification system, such as exists at the famous Naples Zoölogical Station, has thus been unnecessary. Great improvements have been made in pumps, piping, and faucets (p. 68) in the course of the years, to prevent metallic contamination of the water (especially by copper, which is exceedingly toxic), with the present result that the animals in the circulating sea water do as well as those dipped directly from the sea itself.

In connection with the supply department, a business has gradually been developed to supply biological material to educational institutions; its sales furnish occupation throughout the year to the regular members of the department and yield a sum adequate for the support of the entire service. Experienced men are thus in charge; and an extra

THE "CAYADETTA"

force of collectors, usually college men, is engaged for the heavy load of the summer. The temporary positions are in great demand.

The business was started in 1893 by Dr. H. C. Bumpus, then in charge of the course in invertebrate zoölogy, and assistant director in 1894 and 1895. Students and other workers had been in the habit of preserving their independent collections for use in their home laboratories, and this tended to become something of a nuisance. The collector, F. B. Wamsley, was therefore deputed to take over this work, and in the third year sales rose to about $3,500. At that time a change had to be made; and George M. Gray, a graduate of Brown University who had served the Laboratory as technical assistant for three years, was appointed curator of the supply department. At first this was a summer activity only, but in 1899 Gray came to Woods Hole on a full-time basis to develop the business of the supply department. In ten years the business of the department increased to $6,600 a year, by 1919 to $36,671, and in another ten years more to over $62,000, which not only supported the enlarged department but gave it an income of over $9,000 in 1929.

Early in 1919 it had begun to become apparent that there was a much larger demand for biological supplies of the kind the Laboratory was interested in than was being met by the Laboratory; and, accordingly, in that year a controlling interest in the General Biological Supply House, recently established in Chicago, was purchased. By making Chicago a distributing center for the West, a considerable saving of time in delivery and shipping expense could be accomplished; and new lines, such as microscope slides, lantern slides, museum preparations, apparatus, etc., could be developed there without transforming the Woods Hole organization into primarily a business enterprise.

Although the growth of the General Biological Supply House was at first slow, it began, before long, to fulfil all expectations and yielded the Laboratory a much larger income than had been anticipated (IV, A, 2). The Chicago supply house has gradually relieved the local department, and the business of the latter has returned to manageable proportions, so that its primary purpose of service and aid to investigation and instruction has not been overshadowed.

Captain Veeder was associated from the first with Mr. Gray in the work of the supply department, a partnership that lasted until 1933, when Captain Veeder was retired for age on pension after forty-five years of service. Mr. Gray also retired in 1933 after forty-two years of

service; but both, by choice, devoted their leisure years to the interests of the Laboratory. For a period of over forty years there was continuous administration of this essential service. Captain Veeder died in 1940.

No persons in the organization were better known than these two old-time employees. Captain Veeder was "salty." He was born on the island of Cuttyhunk in 1859; accustomed to the management of boats from early years, he acquired a most intimate knowledge of the shoals, tides, currents, and weather conditions of Vineyard Sound and Buzzards Bay. He was in charge of the steamer "Cayadetta," a reconditioned 75-foot steam yacht that succeeded the "Sagitta" in 1906; and he also exercised oversight of the smaller boats used only for collecting, which were under the more direct supervision of Mr. Gray. Captain Veeder was in charge of the class trips and the annual picnics of each class, and he carried thousands during his years of service without an accident. He, more than any other person, was responsible for the record of the Laboratory that no person has ever been lost on the official trips on the water. He kept his eye on the weather and always vetoed a trip when his extraordinary weather sense warned him that it might be dangerous. Many times he came to the rescue of amateur sailors who were in distress or marooned by bad weather or ignorance of tidal currents, and frequently he and his crew went to the aid of small craft grounded on shoals in the Hole or near the harbor.

He had the good old Cape Cod dignity and self-respect; he was a shrewd judge of men in all walks of life and met all on an equal basis. He never regarded his position merely as a job; whatever was "for the good of the Laboratory," as he used to say, was always cheerfully and skilfully performed. He acted as interpreter of the Laboratory to the townsfolk and in town meetings and was helpful in maintaining good and valued relations with the community.

Mr. Gray is of the naturalist type, with the appropriate training and education; and he acquired wider knowledge of the marine organisms of Cape Cod than any other person. He is also well acquainted with the local wild life on land and in the fresh water. It was to him that the investigators turned for their biological needs during his active years. At the time of his retirement in 1933 the collections he had been instrumental in bringing together were united in the museum named the George M. Gray Museum, and he henceforth devoted his time to its further development.

The present staff of the department was brought up and trained under the old leaders. Two have served twelve years, and four others

GEORGE M. GRAY IN HIS OFFICE

from seventeen to thirty years. The present head of the department, Mr. James McInnis, has been in the service twenty-three years. It has been characteristic of the Marine Biological Laboratory that its employees remain with it and share in the life and purposes of the institution. A committee of the scientific workers keeps in constant touch with the department and interprets its needs to the Executive Committee.

5. The Technical Services: Chemical Department, Apparatus Department, and Experimental Radiology

The problem of providing chemical supplies, glassware, and scientific apparatus for the large number and variety of investigators has become as complex as it is important. The policies reached represent a gradual accumulation of the experience of many persons since the foundation of the Laboratory, in this respect resembling other departments. It is obviously impossible to provide everything needed by from three hundred to four hundred investigators, each with his own special requirements; the Laboratory has therefore settled on a distinction between general and more special reagents, glassware, and apparatus, although the line of demarcation cannot be sharply drawn, and on the policy of providing, as a free service, all the more generally used chemicals and glassware for use by the investigators. The more special requirements are stated, on a regular form, by each applicant for accommodations; and he is notified what items it will be necessary to bring with him. Among these are microscopes and most of the special apparatus required for continuous personal use. In addition to furnishing supplies, the chemical department also renders service in the preparation of such solutions as are used in histological and ordinary chemical work, in photography, and in standardization of solutions prepared by investigators themselves. The chemical and apparatus departments are administered separately. The latter has at its service an excellent machine shop and glass-blowing service where repairs can be made and relatively simple construction of apparatus carried out. There is also a very excellent department of experimental radiology. Photographic facilities, service, and [illegible] are available to investigators. In brief, the effort is made to [illegible] the technical services comparable in excellence with the services of the supply department and the library.

Professor O. S. Strong, who conducted this work during earlier and simpler days out of pure devotion to the Laboratory, has written a de-

tailed account of the "Evolution of the Chemical Room" in the *Collecting Net* (Vol. **2,** Nos. 1, 2, 3, and 4 [1927]). From the beginning up to the present, the Laboratory has profited by the advice of members from many universities possessing wide ranges of practical experience. An advisory committee, representing several universities, keeps in touch with the technical departments.

6. General Maintenance: Buildings and Grounds

A general maintenance department is in charge of buildings and grounds. With a carpenter shop and a machine shop the staff is qualified to take care of the repairs and painting of the buildings and the upkeep of the elaborate plumbing and electrical installations. The janitorial, watching, and postal services are under this department. The department also serves investigators directly in the care, installation, and repair of apparatus, whether in wood, metal, or glass, and frequently also in actual construction, when commercial sources are not available.

During the terrible hurricane of September 21, 1938, severe damage was caused to Laboratory property. The tidal wave overflowed the street and the grounds about the main buildings. In spite of the heroic efforts of the staff, the flood broke through the windows of the basement and rose to a level of 4 feet, inundating the apparatus rooms and submerging microscopes and other costly apparatus. Other buildings were also damaged. Fortunately, no lives were lost, as happened in other parts of Woods Hole.

The cost of repairing the damage amounted to about $25,000, none of which was covered by insurance. The Carnegie Corporation generously rose to the occasion, as it had done previously, when it helped meet conditional gifts on three separate occasions, and made a contribution of $20,000, to be used for purposes of restoration.

7. Summary

The plan of administration has been the result of gradual growth. The integration of its various parts is a process of good will as much as of formal organization. The spirit of co-operation runs through it all, for the simple policies and aims of the Laboratory are readily understood and meet with quick sympathy from bottom to top. Co-operation, indeed, requires such understanding and becomes proportional to the sense of dignity and value of the aims and functions of the whole, impressed in the process of living and working together.

CHAPTER VI

Research at the Marine Biological Laboratory The First Twenty Years

I. Introduction

AS THE Marine Biological Laboratory has welcomed all branches of biology for which its facilities were suitable and as it has no preferred problems of its own, its scientific history represents a cross-section of the development of large fields of biology during a period of over fifty years. Many institutions publish lists of publications by their faculties which constitute a record of their research activities. Such publication is, however, not possible in the case of the Marine Biological Laboratory because all of its members are on the faculties of other institutions and accomplish only part of their work at Woods Hole. Certain pieces of work, it is true, are begun and finished at Woods Hole, in either one or more sessions; but a large proportion of the research projects at Woods Hole are later continued in the investigator's own institution. Of this practice there are various degrees, ranging from material originating in Woods Hole exclusively to material originating elsewhere. Whitman published a list of over 150 publications based on work done either in whole or in part at the Marine Biological Laboratory up to 1895,[1] mostly the product of the last four years of this period. In the year 1908 a list of 860 titles of publications up to that date was published.[2] Since then no similar list has been compiled.

It is possible, nevertheless, to trace the progress of research at the Marine Biological Laboratory from the records of workers in attendance which are complete and of research seminars established voluntarily by groups of investigators from time to time; from reports of research in progress published in the *Biological Bulletin*; from the evening lectures, published in book form from 1890 to 1[illegible] the complete lists of later lectures; from abstracts of reports published in the *Collecting Net;* and from various other sources. To these records the

[1] *Annual Report, 1895*, pp. 36–44.

[2] *Ibid., 1907–1908*, pp. 56–100.

writer is fortunately able to add his own personal experiences and recollections, extending through almost the entire history of the Laboratory. There is, therefore, abundant material for following the development of research in the Laboratory throughout the years.

The evening lectures, given once or twice each week, are delivered by investigators in residence, or specially invited for the occasion, on subjects with which they have been working. Begun in 1890, these lectures were intended "to bring specialists into mutually helpful and stimulating relations with one another, and at the same time to make their work and thought intelligible and useful to beginners," and to serve "the rapidly growing need of co-operative union among specialists."[3] So interesting have these occasions been that the Friday-evening streets around the Laboratory have ever since resembled those steel prints of early New England Sabbaths with thronging worshipers on their way to church.

These lectures were published in book form during the nineties—seven volumes in all. As one of the leading objects of the lectures was, Whitman said, to bring forward the *unsettled* problems of the day, they give a good picture of the problems of the times; and, as they were delivered mostly by workers at the Laboratory, they reveal how these problems were approached and developed there. Among the lectures in these volumes are many famous pieces of biological writing, which were highly regarded in their day but have long been out of print. They give a good picture of the changing face of biology during a critical decade.

In 1890 the subjects were: "Specialization and Organization" and "The Naturalist's Occupation," by C. O. Whitman; "Some Problems of Animal Morphology," by Edmund B. Wilson; "The Gastraea Theory and Its Successors," by J. Playfair McMurrich; "Weismann and Maupas on the Origin of Death," by Edward G. Gardiner; "Evolution and Heredity," by Henry Fairfield Osborn; "The Relationships of the Sea-Spiders," by T. H. Morgan; "On Karyokinesis," by S. Watase; "The Ear of Man, Its Past, Present and Future," by Howard Ayers; and "The Study of Ocean Temperatures and Currents," by William Libbey, Jr.

Here was no experimental zoölogy, no general physiology, no biochemistry or biophysics, and no genetics. By contrast, the evening lectures for 1938 and 1939 included such topics as "Blood and Zoölogical Classification," "Neurohumoral Transmission," "Micro-

[3] *Biological Lectures, Marine Biological Laboratory, 1890* (Boston: Ginn & Co.), p. iv.

manipulation Studies on Cells and Nuclei," "Induction of Embryonic Organs," "A Quantitative Approach to the Secretion Process of the Thyroid," "The Influence of Temperature in Evolution as Shown by Genetic Studies in *Drosophila*," "Sexuality and Related Problems in *Paramoecium*," and "Vitamin A and Vision." The shorter scientific papers presented during the same seasons were predominantly biochemical and biophysical.

In short, there has been a complete transfer of interest from the morphological and phylogenetic center of interest in the early days to experimental biology in various aspects. The course of the transition was clearly indicated in the series of volumes of lectures delivered in the nineties. In the second volume, containing the lectures of 1893, the leading topics are in the field of theoretical embryology, including the famous lectures of E. B. Wilson on "The Mosaic Theory of Development," of J. Loeb "On Some Facts and Principles of Physiological Morphology," and of C. O. Whitman on "The Inadequacy of the Cell-Theory of Development." In the later volumes of the series the trend was strongly experimental, in embryology, animal behavior, regeneration, and parthenogenesis.

As early as 1891, Whitman[4] advocated the development of "biological physiology," so named in contradistinction to mammalian physiology as taught in the schools. He cited as examples to illustrate the idea Roux's experiments on the frog's egg, Boveri's experiments on the sea-urchin's egg, the effects of chemical agencies on germ cells as studied by Oskar and Richard Hertwig, Wilson's study on the heliotropism of *Hydra*, Loeb's studies on physiological morphology and on the heliotropism and geotropism of animals, and studies on animal regeneration—these among others; in short, the application of experimental methods to the study of development, general physiology, and animal behavior. He sensed the trends in biological investigation, more pronounced in Europe than in America at the time. The year 1891 marks a definite turning-point in the direction of investigations at the Laboratory.

Whitman did not, however, advocate the dissociation of morphological from physiological research but emphasized, on the contrary, that "the association of morphological and physiological research enlarges the field of vision on both sides—converts half-views into whole views."[5] The turning-point was not of one discipline away

[4] *Annual Report, 1891*, p. 15.

[5] *Ibid., 1892*, p. 35.

from the other but was a harmonized wheeling of both, keeping step together.

It is of considerable historical interest that Agassiz, as early as 1873, clearly foresaw the importance of physiological research for the development of zoölogy and was even prepared to instal physiology at Penikese. A photostatic copy of the following letter in Agassiz's handwriting is on file at the Marine Biological Laboratory:

New York, June 14th, 1873

My dear Sir;

I read in this morning's Tribune a few remarks concerning Dr. Brown-Séquard and the Anderson School of Natural History on Penikese Island, which lead me to infer that some information concerning my plans for that institution may not be unwelcome to you. Natural History is no longer a mere descriptive science today. It aims at improving knowledge by experiment as well as by observation. And from the first day I have known the intentions of Mr. Anderson, I have wished to combine physical and chemical experiments with the instruction and the work of research to be carried on at Penikese. That physiological experiments lay at the very foundation of an exhaustive study of Zoölogy is as plain as the simplest truth. But to do anything worth having in that direction, a master is needed at the head of the department and of course I thought at once of my old friend Brown-Séquard. Hearing of his intention to pay a visit this summer to his scientific friends in Europe, I felt that my hopes for the School were involved in his movements and I at once came to New-York determined to do my utmost to induce him to join me in laying the most solid foundation for the Anderson School. I have so far succeeded that my friend has promised me to give up his journey to Europe and stand by me until the School is fully organised and I know I shall have the sympathy of all the true friends of science in my success. Whether it will be possible for me to induce Dr. Brown-Séquard largely to forego for the present the advantages of medical practice to devote himself hereafter chiefly to physiological experiment, the future may decide. But what I rejoice in is the fact now settled that we shall have, in connection with the Anderson School, a physiological laboratory worthy of the high importance physiology has gained of late years in reference to medical science; and thus the School may extend the range of its usefulness in the application of science to the practical arts of modern civilisation.

With great regard

Yours very truly

Ls. Agassiz

Wm. C. Wykoff, Esq.
Tribune Office
N.Y.

Agassiz's idea did not receive organized expression until nearly twenty years later.

II. The First Twenty Years: 1888–1908

As has been sufficiently set forth in this book, the diversification of subjects of research in the Marine Biological Laboratory has become

very great. An attempt to appraise this situation would be premature even if it were not inadvisable for other reasons. The following account will therefore be limited to about the first twenty years of investigation at the Laboratory. This account will bring into relief the investigations on which the reputation of the Laboratory was originally based, with special reference to the leaders, and the sources of the enthusiasm for research that continues to characterize Woods Hole.

Among these sources, weight should be given to the fact that, unlike many marine laboratories, the Woods Hole Laboratory was always distinguished by the presence of students in the budding stages both of initiation into and of early production in research; some of these were destined to become leaders, in their turn, and devoted supporters of the institution. It would be difficult to exaggerate the part that the example of the beginners' own, and other, friendly professors and the give-and-take of discussion among themselves have played in scientific careers begun and fostered at Woods Hole. Beginners in research have always found a welcome and special provision for their needs in Woods Hole from the opening of the Laboratory until the present day; most of them come with their own professors, but many take advantage of the "staffs of investigation," at first informally arranged, but since 1893 formally set up and announced.

Workers at the Laboratory at the present time who are accustomed to see and meet those who have grown gray and even hoary in the service would be amazed if they could witness the youthfulness of the early corps of investigators. Among the workers in 1892, C. O. Whitman was forty-nine years of age; Hermon C. Bumpus, the assistant director, thirty; Cornelia M. Clapp, forty; E. G. Conklin, twenty-nine; E. G. Gardiner, clerk of the corporation, thirty-eight; Jacques Loeb, thirty-three; T. H. Morgan, twenty-six; William A. Setchell, twenty-eight; O. S. Strong, twenty-eight; W. M. Wheeler, twenty-eight; and E. B. Wilson, thirty-six. The present younger group of investigators, on whom the future of the Laboratory depends, may take heart from this.

The best way of considering the research of the first twenty years seems to be by subjects and main problems of debate. This will have the defect of dividing the work of some gifted investigators under several heads, but this is perhaps a lesser evil than to present a series of scientific biographies which would involve the writer in difficulties of selection and of appraisal of the total works of investigators both living and dead; nothing of the latter kind is intended. Either plan re-

A GROUP OF INVESTIGATORS PRESENT AT THE MARINE BIOLOGICAL LABORATORY IN 1894 (OUT OF THIRTY-SEVEN IN ATTENDANCE)

First row, seated on ground (left to right): Howard S. Brode, Arnold Graf, John P. Munson, Robert P. Bigelow, Gary N. Calkins.
Second row, seated (left to right): W. H. Dudley, Walter M. Rankin, A. D. Mead, Edmund B. Wilson, C. O. Whitman, E. G. Conklin, Hermon C. Bumpus, F. S. Lee.
Third row, standing (left to right): ———(?), Pierre A. Fish, Cornelia M. Clapp, Sho Wakasé, Katharine Foot, A. D. Morrill, Joseph C. Thompson (?), Esther F. Byrnes.
Back row, standing (left to right): M. A. Brannon, Bradley M. Davis, Clara Langenbeck, S. Emma Keith, Margaret Lewis, Louise B.Wallace, J. L. Kellogg, George W. Field, Frank R. Lillie, O. S. Strong, Mary M. Sturges, John McCrae.

sults in the omission of valuable pieces of research because they lie off the main lines subsequently developed, whether through limitations in the material itself or in the problems with which they deal. It is much easier to make a classification by subjects for the period under consideration than to make one for the present time, with its much greater specialization.

1. Animal Morphology

Much of the interest in animal morphology centered at first on the subject of metamerism, under the influence of Whitman, who had a distinct predilection for monographic treatment. Even when engaged on special problems concerning an animal or a group of animals, nothing that the animals did failed to attract his interest or escape his notebook. In Whitman this attitude of the naturalist, in contrast to that of the analytical specialist, was especially strongly developed. Thus, though his work on leeches began with the embryology of *Clepsine* (VI, 135), it soon included the anatomy, taxonomy, and behavior of the Hirudinea. The same branching-out was true when he worked on *Amia* and *Necturus* in the Lake Laboratory, and also later, when pigeons were his chief interest. That such an attitude was common at the Laboratory during its first years was evidenced by the familiar greeting of students meeting then for the first time: it was "What is your beast?" not "What is your special field?" To this was attached a certain possessiveness common to the period: "Nobody should meddle with my beast without my permission, and certainly not in the case of colleagues!"

Whitman's interest in the problem of metamerism grew out of his study of the classification of leeches undertaken in Japan in 1879–81, which followed his first embryological work, on *Clepsine*, published in 1878. As J. Percy Moore states:[6] "To such good purpose did he labor that the history of the systematic study of the leeches may fairly be divided into a pre-Whitmanian and a Whitmanian period." The thread to the maze that he discovered was the arrangement of the segmental sense organs on one ring of each somite and their serial homology with the eyes. This work culminated in a paper published in 1892 (VI, 136) bearing the very modest title, "Metamerism of *Clepsine*," which, to quote J. Percy Moore again, "as an example of complete morphological analysis has few equals among papers dealing with invertebrates." With beautiful technique and marvelous pre-

[6] *Journal of Morphology*, **22**:lii, 1911.

sion "the elements of the central neuromeres and peripheral nerves were correlated one by one with such external features as annuli, sensillae and eyes throughout the body and especially in the simple somites at the two extremities."

The extension of this interest to other invertebrate and vertebrate animals was the major preoccupation of Whitman for a while. He set students to work on the metamerism of other leeches and of annelids, an example of this work being C. L. Bristol's "The Metamerism of *Nephelis*" (VI, 1). W. A. Locy's work on the serial relations of the optic vesicles of elasmobranchs, metameric segmentation in medullary folds, and the segmentation of the vertebrate head (VI, 60) was also inspired by Whitman.

The morphological interpretation of the cranial nerves entered upon a new period in the nineties; the early work of O. S. Strong (VI, 124) and C. J. Herrick (VI, 39, 40, 41) belonged to this period, and much of it was done at Woods Hole. There was so much interest in neuromorphology during this time that a neurological seminar was organized in 1896 by Howard Ayers;[7] the fact that twenty-nine members presented reports in 1898 is some indication of the intensity of interest in this study at the time. Among the contributors to the seminar (1896–99) were such well-known investigators as C. R. Bardeen, Cornelia M. Clapp, Ulric Dahlgren, C. J. Herrick, J. B. Johnston, B. F. Kingsbury, F. L. Landacre, F. S. Lee, W. A. Locy, E. P. Lyon, M. M. Metcalf, T. H. Montgomery, A. D. Morrill, H. V. Neal, G. H. Parker, Stewart Paton, William Patten, O. S. Strong, E. L. Thorndike, Ira van Gieson, F. C. Waite, and R. M. Yerkes. The work extended from morphology into physiology and even into animal behavior. The organization seems to have died out after 1899 or to have been merged into a general research seminar established soon after. However, the interest in neurological work has never disappeared at the Marine Biological Laboratory.

In addition to these rather well-marked divisions, a good deal more specialized morphological work was under way. William A. Patten's work on *Limulus* and the ancestry of vertebrates was a conspicuous example (VI, 114, 115, 116); J. P. McMurrich's work on the taxonomy of sea anemones and their relatives (Actinozoa) was another (VI, 90, 91). After Gilman A. Drew joined the Laboratory in 1900, he carried out his important studies on the anatomy and habits of the lamellibranchs (VI, 27, 28). While assistant director, he published his really

[7] *Annual Report, 1896*, pp. 66–71.

classical studies on the squid (*Loligo*), one of the most finished and complete accounts of reproductive anatomy and behavior in any invertebrate (VI, 29, 30).

William Morton Wheeler was one of the inspiring young investigators at Woods Hole from the second session in 1889 to 1892, and again in 1894. He was engaged at first in his classical work on insect embryology; in 1894 he published fine descriptions of two new flatworms from the Woods Hole regions—*Planocera* (gen. nov.) a polyclad parasitic in the mantle cavity of the snail *Sycotypus* (VI, 134), and *Syncoelidium*, a triclad parasite of *Limulus* (VI, 133)—before beginning his lifelong studies on ants. He was a broadly cultivated and philosophical naturalist whose influence on his younger associates was beyond price.

2. The Early Studies in Embryology

Embryology has always been a favorite subject at Woods Hole. It occupied the center of interest for many years, along with related fields of morphogenesis, such as fertilization and regeneration. During the summer Woods Hole is a paradise for students of development, whether for observation or experiment, because this is the season of reproduction of most of the marine animals there. Sea urchins, starfish, and sand dollars cast their innumerable small eggs directly into the sea water; by artificial fertilization these can be secured in cultures of identical age in any desired quantity; series of stages may be preserved at suitable intervals; or the development may be observed in living condition under the microscope. The same cultures may be used for experiments of any desired kind. The eggs of many annelids, lamellibranchs, tunicates, and bony fishes offer similar advantages. Snails and squid lay their eggs within various kinds of protective envelopes in profusion. Sharks and skates provide relatively primitive types of vertebrate development. Hydroids, medusae, flatworms, and many other forms furnish material for the study of regeneration and regulation. The list of available material might be further prolonged; but this will suffice to indicate the vast superiority of opportunity of a marine laboratory over any university laboratory.

In the first two years the available material was being appraised, and the first display of general enthusiasm was that over "cell lineage," the name that E. B. Wilson gave to the study of the cell-by-cell origin of body regions and organs characteristic of the development of annelids, most mollusks, many crustacea, the tunicates, and a few other animals, in which the cleavage of the egg is determinate.

General embryological theory was dominated from 1860 up to about 1890 by the theory that the development of the individual recapitulates in brief form the development of the race; or, in Ernst Haeckel's words: "Ontogeny is a brief and rapid recapitulation of phylogeny." Embryology was the handmaid of evolution; the earlier stages of development were interpreted in terms of the "Gastrea Theory and Its Successors" (VI, 89), and the theory of homology of germ layers was the basis of all organogeny. In 1878 Whitman broke away from the germ-layer theory in his paper on "The Embryology of *Clepsine*," an epoch-making study, although only his dissertation for the Ph.D. degree (VI, 135). In that paper he observed the bilateral symmetry of the egg before cleavage and traced the principal organs to individual blastomeres. He expressed his general conclusions in the following words: "In the fecundated egg slumbers potentially the future embryo. While we cannot say that the embryo is predelineated we can say that it is predetermined." In these words he dismisses phylogeny as the principal determiner of development and substitutes the species organization, as was implicit in older conceptions of development in the eighteenth century.

E. B. Wilson's classic work on "The Cell-lineage of Nereis," published in 1892 (VI, 143), was the starting-point of a similar series of studies at Woods Hole. While this investigation was still in progress in 1891, E. G. Conklin was working on the cell lineage of *Crepidula* (VI, 10, 11), and three of Whitman's students on other forms: A. D. Mead (VI, 92, 93) and A. L. Treadwell (VI, 129) on annelids and F. R. Lillie on the lamellibranch *Unio* (VI, 49). There was much discussion, and Wilson played the part of an elder brother. The writer was thrilled by Wilson's remark to him in 1891: "I believe I am going to destroy the germ-layer theory of development!" For to the listener, as an eager student of twenty-one engaged on his first investigation, there was something sacrosanct about this theory in which he had been indoctrinated as an undergraduate student; and this remark taught him the difference between scientific theory and dogma. This incident was a characteristic setting to which so much of the stimulus of Woods Hole was due. Over all this work Whitman brooded; and he followed it closely, because the work on cell lineage confirmed and extended his views, which at first had met a bad reception. Later Conklin was to put out his beautiful study on "The Organization and Cell-Lineage of the Ascidian Egg" (VI, 14, 15), and C. M. Child a careful study and critique based on the cell lineage of the annelid *Arenicola* (VI,

5, 6). H. E. Crampton's observation (VI, 20) that in the snail *Physa*, which has a sinistral shell and asymmetry, reversed in contrast to the usual dextral shell of related genera, the spiral form of the cleavage is also reversed, sinistral instead of dextral, was very illuminating with respect to interpretation of cleavage form.

The work on cell lineage was descriptive and comparative, not experimental, at first; but it was analytic in the best sense of the word—first, because it helped to clear away both Haeckelian and Weismannian theories, and, second, because it established certain viewpoints that could be used as hypotheses for experiment. The germ-layer theory in the old phylogenetic sense had to go, and the theory of nuclear specialization by the karyokinetic mechanism received a hard blow. If the formative energies have their seat in the cytoplasm, in what way are they disposed? What is the organization of the egg? What the role of the nuclei in development? What is the meaning of the arrangement of cells like a planned mosaic, each part with a specific prospective significance? These questions were destined to occupy embryologists for a long time, and the study of cell lineage brought them into sharp focus.

Cell lineage bore also upon one of the main embryological problems of the day, "isotropy" of the ovum, as it was called—the view that all parts of the ovum are of equal value whether with reference to the main axes of the embryo or to the prospective significance of its parts. This was the radical epigenetic view of development held strongly for a time by Driesch and Jacques Loeb, among others, but anathema to most embryologists at Woods Hole. It was impossible for any student of cell lineage who observed the regularity and precision of the first cleavage planes with reference to preformed poles of the egg, and the determination of direction, rate, and place of subsequent cleavages in relation to the first, together with the invariable prospective significance of cells so derived, to be misled by any such oversimplification.

The study of cell lineage is generally regarded as a passing episode in embryological research; but it did not engage so many good minds, both at Woods Hole and elsewhere, without leaving its mark on subsequent embryological research. Such questions as the homology of cleavage cells in species, classes, and even phyla; ancestral reminiscence in cleavage (VI, 146, 147*a*); adaptation of cleavage form to subsequent organization (VI, 49*a*); and the factors regulating the direction, rate, and equality or inequality of cell divisions may not be

much discussed now; but they influenced the course of experimental embryology then in a very direct manner, and indirectly the whole subsequent theory of development.

Some of the results of the study of cell lineage were summarized by Conklin as follows:

> Wilson emphasizes the following important resemblances between the early cleavage stages of the annelid, the polyclad, and the gasteropod: (1) the *number and direction of the cleavages* is the same in all three up to the 28–cell stage; (2) in general, the cells formed are *similar in position and size*, *viz.*, there are four macromeres, three quartettes of micromeres, and the first quartette is surrounded by a belt composed of the second and third quartettes. The first quartette undergoes three spiral divisions in alternate directions, and the second quartette divides once. Here the resemblance with the polyclad ceases, though the annelid and gasteropod go one step further in these likenesses, *viz.*, (3) the *three quartettes of micromeres are ectomeres* in the annelid and gasteropod, and (4) in both these groups *the mesoblast is formed from the cell 4d*, which gives rise to paired mesoblastic bands.
>
> Beyond this point Wilson believed that the annelid diverged from the gasteropod. He supposed that the "cross" in the two was wholly different both in origin, position, and destiny, and that the velum had a wholly different origin from the annelidan prototroch.
>
> Lillie has extended all the above-mentioned resemblances between annelids and gasteropods to the lamellibranchs, and in addition has discovered the following: (5) *the first somatoblast* (*2d*), which gives rise to the ectoderm of the trunk, has exactly the same origin and position and a similar history in the annelid and lamellibranch; (6) it gives rise to a *growing point* and a *ventral plate* in all respects essentially like those of the annelids. Lillie shows good reason for believing that in other mollusks the posterior growing point is derived from these cells.
>
> To this list of resemblances between the annelid and the mollusk, which I can confirm in the case of the gasteropod, I have been able to add the following: (7) the *rosette series* of the gasteropod is exactly like the *cross* of the annelid in origin, position, and probably in destiny. The *intermediate girdle cells* of the annelid are like the *cross* of the gasteropod in origin, position, and destiny (at least in part). The differences, therefore, between the annelidan and molluscan cross which Wilson emphasizes are not real ones; (8) the *trochoblasts* of the annelids and gasteropods are precisely similar in origin and destiny (at least in part). In some annelids (Amphitrite, Clymenella, Arenicola), the prototroch is completed by cells of the same origin as in Crepidula and Neritina. The differences which Wilson points out between these two structures do not, therefore, exist. In both annelids and mollusks the prototroch lies at the boundary between the first quartette on one side and the second and third on the other. In both there is found a preoral, and adoral, and a post-oral band of cilia; (9) in the gasteropod the apical cells give rise to an *apical sense organ* such as is found in many annelid trochophores; (10) the *supra-oesophageal ganglia and commissure* apparently arise from the same group of cells in annelids and gasteropods; (11) the *fourth quartette* in annelids and gasteropods contains mesoblast in quadrant D, but is purely entoblastic in quadrants A, B, and C; (12) a *fifth quartette* is formed in gasteropods and some annelids (Amphitrite, etc.), and consists of entoblast only; (13) in the gasteropod *larval*

mesoblast arises from the same group of ectoblast cells as in Unio, differing, however, in this regard, that it is found in quadrants A, B, and C, whereas in Unio it is found in quadrant A only; (14) to this list of accurate resemblances in the cleavage cells may be added the fact that *among annelids and mollusks the axial relations of all the blastomeres (except possibly the four macromeres) are the same.*

What a wonderful parallel is this between animals so unlike in their end stages! How can such resemblances be explained? Are they merely the result of such mechanical principles as surface tension, alternation of cleavage, etc., or do they have some common cause in the fundamental structure of the protoplasm itself? Driesch answers: "The striking similarity between the types of cleavage of polyclads, gasteropods, and annelids does not appear startling; it is easy to understand this, since cleavage is of no systematic worth." To this, I think, it need only be said in reply that if these minute and long-continued resemblances are of no systematic worth, and are merely the result of extrinsic causes, as is implied, then there are no resemblances between either embryos or adults that may not be so explained. And, conversely, these resemblances in cleavage, however they have been produced, stand upon the same basis with adult homologies [VI, 10 and 11].

3. Experimental Embryology

Jacques Loeb's experiments on the production of multiple embryos in the sea urchin (VI, 63) followed on the "egg-shaking" experiments of Driesch in Naples, by which Driesch isolated the first four cells —among other things—and found that each of these gave rise to a small but complete larva instead of a fractional quarter, as might have been expected if preformed germ regions existed in the egg or if the process of division gave rise to nuclei of special potencies, as Weismann had assumed. Loeb made a series of experiments by an entirely different method, which at first sight seemed also to exclude specification in the protoplasm of the egg or in the nuclei as a result of division. After fertilization, eggs of the sea urchin were placed in dilute sea water (equal amounts of sea water and distilled water mixed together) and, as a consequence, swelled up until the membrane burst and part of the protoplasm flowed out through the opening, though usually remaining connected by a bridge with the part within the membrane. The eggs in mass culture were then returned to normal sea water, swelling stopped, and development proceeded. From such cultures dwarf embryos, Siamese twins, even triplets, and rarely quadruplets developed according to whether the extra-ovate had become separated or one, two, or three extra-ovates had remained coherent with the part within the membrane.

Loeb concluded that "the number of embryos which come from one ovum is not determined by the preformation of germ regions in the protoplasm, or nucleus, but by the geometrical shape of the ovum

and the molecular condition of the protoplasm, in so far as these conditions determine the number of blastulae." The fact that an ovum gives rise usually to but a single embryo "is due simply to the geometrical shape of the protoplasm, which under normal conditions is that of a sphere" (VI, 63, p. 58).

It can be imagined how this conclusion clashed with the views of other Woods Hole embryologists and the debates that ensued! It was much later that the defects of observation, and hence of interpretation, of Loeb's experiments became cleared up by the work of Boveri and by many experiments continuing down to our own time. At any rate, the views of Loeb serve to show that opinion was not regimented or stereotyped at Woods Hole but that all varieties of opinion were free. The simplicity and originality of Loeb's methods and conclusions are well illustrated by the foregoing example.

Following the epoch of cell lineage at Woods Hole, but overlapping it to a considerable extent, embryological study and analysis were pursued there, mostly by experimental methods. Loeb did not follow up his sea-urchin experiments, and his adoption of isotropy of the ovum did not influence subsequent investigation. The principles established by cell lineage were examined by experimental methods first by Crampton (VI, 21), who found that in the marine snail *Ilyanassa* isolated blastomeres of the two- and four-celled stages segmented exactly as in the normal egg and produced partial larvae. This fact was an excellent antidote to strict isotropy! At the same time, in Naples, Driesch and Morgan (VI, 31) showed not only that segmenting eggs of ctenophores behaved similarly but also that localized defects in the unsegmented egg produced corresponding defects in the larvae. Thus the way was prepared for theories of organ-forming germ regions in the egg and later of "organ-forming substances."

The chapter in experimental embryology that immediately followed from this is a long one, with important contributions from Woods Hole investigators, who sometimes, as in the case of E. B. Wilson, went elsewhere for their material. It is, indeed, too long to receive any critical consideration in this place.

E. B. Wilson's work on the mollusks *Dentalium* and *Patella* (VI, 149, 150) deserves an honored place in this record. It was an experimental analysis of cell lineage and regional localization in the eggs of these forms. With reference to the former subject, he showed that the normal prospective potencies of the blastomeres of these eggs were preserved after their isolation, even in quite late stages of

cleavage, from which it followed that intrinsic properties of the blastomeres were factors in prospective significance at least as important as localization in the whole. He also showed that localized germ regions existed in the unsegmented egg of *Dentalium*.

Attention then shifted to the underlying causes of the intrinsic determining qualities of blastomeres and became focused upon optically differentiated substances in the egg which frequently, at least, acquire, by protoplasmic streaming before cleavage sets in, localization corresponding to definite regions or organs of the embryo. The question naturally occurred whether these substances are primary determiners of specific potencies or mere indicators of a more intimate organization. By far the best treatment of this subject is contained in Conklin's papers (VI, 13, 19) on the early development of ascidians in which preliminary analysis by detailed study of cell lineage was followed by experiment.

In the egg of *Cynthia* the substances are especially clearly marked by their color. After fertilization there is a process of rapid streaming in the protoplasm which, before cleavage, culminates in the formation of a yellow crescent centered on the posterior side of the egg, and derived from an originally superficial layer of protoplasm containing yellow granules; above this there is a similarly shaped area of clear protoplasm; the remainder of the egg is tinged gray by yolk. At the end of the first cleavage, six different kinds of oöplasmic materials are clearly marked out, "each of which gives rise to some specific portion of the larva and is here present in its definitive position and proportions." In the process of cleavage these substances are segregated into specific cells. In experiments Conklin showed that the development of the isolated blastomeres is strictly partial in accord with their cell lineage and prospective potencies. Although it was not possible to isolate the substances as such, but only the cells containing them, he concluded provisionally that they are organ-forming substances (VI, 13). Later (VI, 19), by means of a relatively light centrifugal force, he succeeded in displacing the granules in which the color resides without displacing the area itself, and this did not seriously interfere with the normal development. However, if the areas themselves are displaced by a stronger centrifugal force, determination follows the areas, and very bizarre monsters are produced. The distribution of the colored granules would therefore appear to be due to more intimate physical and chemical differences in the organ-forming germ areas.

The use of the centrifuge in experimental embryology was first suggested at Woods Hole by the physiologist E. P. Lyon (VI, 82, 83). F. R. Lillie (VI, 52) used the method in his studies on *Chaetopterus;* and slightly later T. H. Morgan, in co-operation with Lyon (VI, 109), studied the development of centrifuged eggs of *Arbacia;* in both cases fertilization occurred after centrifuging. The centrifuges used in these experiments were hand-operated and of no great power; nevertheless, they produced sharp separation of substances at the two ends of the centrifugal axis with an intervening, rather broad zone of hyaline protoplasm. It was presumed that the eggs did not orient in the centrifuge in accord with their intrinsic polarity. Thus, after centrifuging the eggs in mass, two axes could be distinguished—the intrinsic (primary axis), marked by the polar bodies in *Chaetopterus*, and the centrifugal (secondary axis), which might, however, happen to coincide in a small percentage of cases. In *Chaetopterus*, by use of the speedier haematocrit attachment, it was possible to produce a pinching-off and separation of the secondary polar masses, leaving non-granular, hyaline spheres of protoplasm which divided after fertilization into two unequal cells of normal proportions.

Lillie concluded (VI, 53) that the primary axis persists as the axis of development and that polarity and bilaterality of the egg are properties of the hyaline protoplasm (ground substance). The studies of Morgan and Lyon (VI, 109), Morgan (VI, 108), Morgan and Spooner (VI, 110), E. G. Conklin (VI, 16, 17, 18, 19), and E. B Wilson (VI, 152) demonstrate the fruitfulness of this method of analysis in experimental embryology. The immense increase in power of the modern centrifuge and the beautiful method of observing effects in the living egg during centrifuging developed by Harvey and Loomis (VI, 38) promise advance toward accurate knowledge of the intimate structure of living protoplasm, on which embryonic development depends.

Other studies in experimental embryology during this period include the papers of T. H. Morgan on teleosts (VI, 100, 101), J. Loeb on the physiology of coloration (VI, 62), Stockard on the production of cyclopean eyes in *Fundulus* by action of magnesium chloride (VI, 123), Newman on *Fundulus* hybrids (VI, 111), and F. R. Lillie on differentiation without cleavage (VI, 51, 52).

4. Regeneration

The study of regeneration and regulation in relation to theories of morphogenesis received a new impetus by the work of Jacques

Loeb on "physiological morphology." He had begun this work at Naples before casting his lot with America at Bryn Mawr College in November, 1891, and it was the first of the scientific interests that he proceeded to develop at Woods Hole in 1892. The next year in one of the evening lectures, he expounded his views on heteromorphosis and environmental determination of the localization of polyps and "roots" in hydroids (VI, 63). He showed very conclusively that geotropic or stereotropic reactions, positive or negative, determined the location of these "organs," so that a root might form on the polyp end of a colony, or vice versa (heteromorphosis), when external relations to gravitation or contact were reversed from the normal. This was the partial answer to his question: "What are the circumstances which determine that only one kind of organs originates at certain places in the body?" (VI, 63). He was well aware that the answer was only partial; and he proceeded to show that an internal factor, polarization, which he compared to persistence of north and south poles in pieces of a broken magnet, determines regenerative localization in *Cerianthus* and that heteromorphosis cannot be produced in this and many other animals. Heteromorphosis and polarization may be exhibited together in other animals—for example, *Tubularia*. His interest in problems of regeneration continued throughout his life and was finally evidenced by his book on *Regeneration from a Physico-chemical Viewpoint* (VI, 76), based on studies on a plant, *Bryophyllum*, and completed just before his death in 1924.

T. H. Morgan also was very active for a good many years in the experimental analysis of regeneration from about 1896. Much of the work was done at Woods Hole and is listed in the annual report for 1908. He published a book on the subject in 1901 (VI, 106). His evening lectures in 1898 (VI, 102) and 1899 (VI, 104) reviewed the history of experiments and presented a critique of theories old and new. His own work, which covered a large number of forms (worms, flatworms, hydroids, medusae, amphibians, and teleosts), contributed many new facts, established in answer to specific questions concerning polarity, heteromorphosis, "morpholaxis," and external factors, among others, so that the subject was left in a condition that furnished a point of departure for all subsequent work in the field. He did not pretend or attempt to furnish any simple answers. The difficulty of analysis was always clearly set forth. The later work of C. M. Child, done elsewhere, has furnished new ideas—of axial gradients and physiological isolation, for instance—and others have dealt with

internal chemical conditions; but regeneration as a field of general morphogenesis still remains stony ground.

5. Fertilization and Parthenogenesis

The fertilization of the egg was also a subject of much investigation and debate at Woods Hole from 1892 on. The way for explanation of the equivalence of the spermatozoon and ovum in inheritance had been cleared by the discovery that the sperm nucleus and the egg nucleus contribute equal numbers of chromosomes to the zygote nucleus and by the theory that these persist individually throughout the life-history. But the manner in which the egg and the spermatozoon, each incapable of development alone, produce by their union a single cell capable of division and development was still a matter of sharp debate. Boveri, in 1887, had propounded the theory that the ovum is devoid of the "organ of cell-division," the centrosome, and that this lack is restored by the introduction of a centrosome into the egg by the spermatozoon.

This theory was the original focus of interest in fertilization at Woods Hole. It had been complicated by the brief glory of Fol's theory of the "quadrille of the centers," according to which both egg nucleus and sperm nucleus were accompanied by a centrosome, which divided each in two: The parts then separated and each united with a partner of the opposite sex to form biparental centers of the first cleavage spindle. E. B. Wilson and A. P. Mathews' classic paper on the maturation, fertilization, and polarity of the sea-urchin egg (VI, 153) was devoted specifically to an examination of this question, which proved fatal to Fol's theory and supported Boveri's contention that the centers of the first cleavage are derived directly from the spermatozoon. Morphological studies by Conklin (VI, 9, 12) and Lillie (VI, 50) indicated rather fundamental variations in *Crepidula* and *Unio*, respectively, in the behavior of centrosomes and asters prior to the establishment of the first cleavage spindle. A very beautiful study by Katharine Foot (VI, 34) on fertilization in the earthworm yielded the suggestion that the phenomena were to be interpreted not in terms of cell organs but rather in terms of nucleoplasmic reactions at certain critical times. In short, it became clear that the initiation of the development of the egg was not to be explained in morphological terms.

In 1897 A. D. Mead (VI, 93) came forward with the pregnant suggestion that the phenomenon of activation of the egg is to be under-

stood in terms of stimulus and response, and he demonstrated experimentally that potassium chloride in appropriate concentrations in the sea water activated the eggs of *Chaetopterus*, just as the spermatozoon does, by formation of polar globules and a yolk lobe; the eggs than began to break up into irregular blastomere-like segments with the formation of extensive radiations in the protoplasm. Apparently, the observations on such cultures were not further prolonged, and the full results of this activation were not observed. However, he stated: "It is a natural inference from these phenomena that in normal fertilization the entering sperm stimulates these mitotic activities in a similar manner, i.e., by exerting a chemical influence upon the egg and not by furnishing the egg with special organs of division."

Morgan studied the effects of salt solutions—magnesium, potassium, and sodium chlorides (VI, 103)—and later also (VI, 105) of strychnine, in sea water on the activation of unfertilized sea-urchin eggs. The salt solutions caused the formation of astrospheres in the egg, transportation of dividing chromosomes by the astrospheres, and irregular cell division. Cell division also followed the action of strychnine, but without the formation of asters. Morgan ventured the suggestion that the cell division might be the result of plasmolysis and compared the action of the substances to that of various stimuli on nerve and muscle.

It will be seen how nearly these results come to a complete anticipation of Jacques Loeb's famous discovery of artificial parthenogenesis, made also in the Marine Biological Laboratory (1899–1900). In 1892 (VI, 61) Loeb had studied the effects of hypertonic sea water on fertilized eggs and had demonstrated the existence of nuclear division without cell division at certain concentrations. In 1896 his pupil, W. W. Norman (VI, 113), carried the same subject further. Loeb was also investigating the fundamental role of ions in other protoplasmic functions at this time. It was natural for him, therefore, to apply the same methods to unfertilized eggs after Mead's and Morgan's observations. These experiments resulted in the development of normal-appearing larvae (plutei).

Loeb obtained successful results in 1899 by combining increased concentrations of the sea water with changes in the proportions of the salts, determined by a preliminary set of experiments. Specifically, the first parthenogenetic plutei were produced by the immersion of the eggs in a mixture of equal parts of "$2\frac{1}{2}$ n $MgCl_2$" and sea water for about two hours. "When brought back into normal sea-water they

began to segment and form blastulae, gastrulae and plutei, which were normal in every respect." This experiment captured the popular imagination and did much to publicize the Laboratory (VI, 65, 66, 69, 70, 71).

The development of the subject of artificial parthenogenesis is much too complicated to be followed here. Loeb also studied the subject in annelids while still at Woods Hole (VI, 72), and later he continued his investigations, with characteristic enthusiasm and vigor, during his appointment in the University of California (1902–10). At the Hopkins Marine Station in Pacific Grove he developed new methods and theories, both of parthenogenesis and fertilization, described in detail in his book on these subjects (VI, 75). The work led him into related fields of general physiology, such as the natural death of the egg, the action of foreign blood, heterogeneous hybridization, the relation between fertilization and cytolysis, problems of cell permeability, and the physiological effects of acids and bases in protoplasm—studies which were continued after his return to Woods Hole as a regular worker in 1910.

After Loeb's original experiments, artificial parthenogenesis was studied also in various European laboratories. At Woods Hole the eggs of the starfish were studied by A. P. Mathews (VI, 85), who showed that mechanical agitation would produce parthenogenesis; by A. W. Greeley (VI, 37), who showed that brief exposure to low temperatures (3°–4° C.) would produce larvae; and by R. S. Lillie (VI, 59), who showed that exposure to high temperature (31° C. for fifteen minutes or 32° C. for about ten minutes) would cause development in as high a proportion of the eggs as fertilization itself. Some additional studies on *Arbacia* and certain annelids were also made before 1908. Studies on the physiology of fertilization and its relations to parthenogenesis came later.

6. Cytology

Embryology brought its cytological problems, at first dealing with the structure of the cytoplasm, with special reference, naturally, to ova. E. B. Wilson (VI, 147, 148) made a careful microscopical study of the cytoplasm of the eggs of echinoderms, both living and in sections, concluding that it is "a liquid or rather a mixture of liquids in the form of a fine emulsion consisting of a continuous substance in which are suspended drops of two orders of magnitude and of different chemical nature, as indicated by their staining reaction." These observations

he set against the background of classical theories of protoplasmic structure; and with his customary perspicacity he expressed the opinion that,

> if we except certain highly specialized structures, the hope of finding in visible protoplasmic structure any approach to an understanding of its physiological activity is growing more, instead of less, remote, and is giving way to a conviction that the way of progress lies rather in an appeal to the ultra-microscopical protoplasmic organization and to the chemical processes through which this is expressed.

It is not too much to say that Wilson's analysis marked the end of theories of protoplasmic structure developed in the preceding twenty years which were becoming unfruitful and that it proved to be an introduction to future work.

The new chromosome era was approaching in the nineties after the pioneer work of Flemming, van Beneden, Rabl, and Boveri in Europe. Nowhere was the new era so signally marked as in America, and nowhere so concentrated as in the summer sessions at Woods Hole. These studies proceeded from the doctrine of the persistent individuality of the chromosomes (Rabl, Boveri), the fact that egg and sperm contribute equal numbers of chromosomes to the fertilized egg, and the conclusion that all cells of sexually produced organisms contain equal numbers of paternal and maternal chromosomes. These were basic propositions of the entire chromosome theory of heredity, destined to reach such a height in our time.

The relation of the Marine Biological Laboratory to the development of the chromosome theory at this time was that of host to some of the principal investigators of the problems, notably, T. H. Montgomery, E. B. Wilson, and T. H. Morgan; and the benefit to the Laboratory, as in so many other cases, was the contact of the scientific community with the work. In this field even the procuring of the material (various kinds of insects) was not specially dependent on the Laboratory.

Montgomery's studies on the nucleolus (VI, 94, 95) led him to distinguish a special kind in the spermatocytes of the hemipteran *Euschistus*, derived from one of the chromosomes of the spermatogonia and hence named by him the "chromatin nucleolus." Later this was to be identified as the X chromosome. His interest was thus diverted to the chromosome groups of the hemipterans. A very extensive study (VI, 96; cf. also VI, 98) led him to important generalizations, which he stated for the first time, viz., that differences in size occur regularly in pairs in the diploid chromosome groups, in each of

THOMAS H. MONTGOMERY, ABOUT 1906, AGE THIRTY-THREE, WHILE AT THE UNIVERSITY OF TEXAS

which pairs one member is of paternal and the other of maternal origin; that the homologous members (i.e., of the same size) unite with one another in the synapsis that precedes reduction from the diploid to the haploid condition; and that these separate in the reduction division of the spermatocytes, which constitutes, therefore, a disjoining of male and female homologues. This was written before the rediscovery of Mendel's laws of heredity by Correns, De Vries, and Tschermak in Europe; and hence no genetic deductions were made by Montgomery. However, the natural deductions were soon drawn at Columbia University by Wilson's student, W. S. Sutton (VI, 125, 126), who stated the complete parallelism between Mendelian phenomena of heredity and the behavior of the chromosomes in gametogenesis.

The subject of the sex chromosomes was being actively investigated and discussed at Woods Hole. In this, E. B. Wilson took the chief part. Previous studies had established the existence and behavior of a peculiar chromosome in the spermatogonia of hemiptera and its distribution to only half of the spermatozoa (Henking, 1891; Paulmier, VI, 117; Montgomery, VI, 96, 97; cf. also VI, 98), but its interpretation remained obscure. McClung observed it in grasshoppers in 1899 (VI, 87); and in 1902 (VI, 88) he stated the theory that "it is the bearer of those qualities that pertain to the male organism," that eggs fertilized by the spermatozoa containing the "accessory chromosome" develop into males, and, conversely, that eggs fertilized by spermatozoa lacking this chromosome develop into females. This was the first statement of the sex-determining function of specific chromosomes.

But it was Wilson who first presented the theory of sex chromosomes on which all subsequent interpretation has rested and by which the peculiar behavior of sex-linked characters in heredity is explained. The theory was based on a long series of observations recorded in a really classic series of papers published between 1905 and 1913. Nettie M. Stevens (VI, 120; cf. also VI, 121, 122), simultaneously with Wilson, discovered sex differences in the chromosome composition of males and females of an insect and their correlation with two types of spermatozoa, one containing a smaller Y chromosome and the other an X chromosome, which she interpreted as male- and female-producing, respectively. In the second of Wilson's papers (VI, 151, p. 543) he states his conclusion that "the chromosome combination, established at the time of fertilization, is, in these insects, the determining

cause of sex." Specifically, both for XO and XY types, the spermatozoon containing the X determines the egg that it fertilizes as a female, and that in which it is lacking (XO type) as a male; or, in different species (XY types), that which carries the Y chromosome determines male development. This theory was the reverse of McClung's original theory; and it was based on comparisons of female, as well as male, chromosome groups, the composition of the female group having been previously unknown. The further development of the theory would carry us beyond the period of pioneering and the limits of space.

T. H. Morgan's beautiful studies on parthenogenesis in phylloxerans and aphids (VI, 107) were partly carried out at Woods Hole during this period. Among other important results, the explanation of the puzzling fact that all fertilized eggs of these forms became females was explained by showing that spermatocytes lacking the X chromosomes do not form spermatozoa but degenerate, so that all functional spermatozoa are of the X-containing type.

7. Genetics and Evolution

The only work at the Marine Biological Laboratory that may properly be classed under this head prior to 1908 was Whitman's work on pigeons, but this was so prominent a feature of the scientific activities at Woods Hole that it cannot be omitted. For a period of about eighteen years, ending only with his death in 1910, Whitman's main scientific interest, to which he devoted most of his time, was the study of the evolution and inheritance of specific and varietal characters in pigeons. O. A. Riddle states in his contribution to F. R. Lillie's biographical sketch of Whitman (VI, 54) that Whitman made a general survey "of the color patterns of nearly six hundred wild species, and of nearly two hundred domestic races of pigeons," and that he kept and hybridized in his yards "nearly forty wild species." He had an artist at work most of the time, and innumerable photographs were also taken. He kept voluminous notes on heredity, behavior, fertility, voice, etc. But of the immense mass of accumulated material, he published little in his lifetime. Two brief papers—one of only two, and the other of eight, pages—and two addresses on the problem of the origin of species (VI, 138, 139, 140, 141) were the only publications by Whitman in his lifetime on the subject, apart from incidental references in his lecture on animal behavior (VI, 137).

For many years Whitman was never dissociated from pigeons at Woods Hole. Year after year, he brought his large collections in an

express car from Chicago to Woods Hole, where he had built a duplicate set of cages behind his house. His home and yards were never free from the cooing of doves, and one of the most familiar sights was Whitman in personal attendance on his charges, generally meticulously dressed, though one could only wonder how he kept so.

Whitman was never greatly impressed with the Mendelian theory and had little confidence in chromosomes. There was nothing in the hybridizing of species of pigeons that received illumination from the Mendelian laws; moreover, his work had begun long before their rediscovery, so that he never got into the highway of modern genetic research. He had a passion for perfection, and the difficult and massive investigation on which he was launched did not lend itself well to piecemeal reporting; the task of ordering and assembling so many years of slow and patient observation and experiment seemed to be dreaded and became too great for him. But his example and the illumination of his conversation were potent influences in the scientific community at Woods Hole. After his death in 1910 his devoted student and friend, Oscar Riddle, took over Whitman's unfinished manuscripts; and, with the aid of the Carnegie Institution of Washington, Whitman's entire collection of pigeons was transferred to the Station for Experimental Evolution at Cold Spring Harbor, Long Island, New York. After eight or nine years, devoted to editing and the completion of observations, the results were published in three magnificent quarto volumes (VI, 142).

8. General Physiology

General physiology was established at Woods Hole in 1892 with provision both for instruction and research and has remained ever since one of the most stimulating divisions of the work. Jacques Loeb led the department at the invitation of Professor Whitman, who felt from previous acquaintance that Loeb was the best-qualified man in America for the purpose. The conception of general and comparative physiology was new only in America. Loeb (VI, 64) traced it back to Tiedemann (1808) and through Robert Mayer (1845), Helmholz, and Johannes Müller, the last of whom is generally regarded as the founder of comparative physiology, to Claude Bernard, the great French physiologist whose book on the phenomena of life common to animals and plants (1885) is one of the great classics of biology. Although the idea was by no means new, various things combined to delay the progress of general physiology: after Johannes Müller, pre-

occupation with the cell theory and the theory of organic evolution, and after Claude Bernard, the work of Pasteur and the almost total immersion of scientific medicine in bacteriology caused neglect of physiology in its more general forms. Loeb became the prophet of general physiology in America.

Loeb defined general physiology as identical with the energetics of vital phenomena and thus limited himself strictly to the mechanistic conception of life (VI, 74). This established both his strength and his weakness—strength because it enabled him to see complex phenomena in amazingly simple terms and devise experiments accordingly; weakness because he became satisfied with very incomplete interpretations. Claude Bernard saw vital relations more broadly:

> Admitting that vital phenomena rest upon physico-chemical activities, which is the truth, the essence of the problem is not thereby cleared up; for it is no chance encounter of physico-chemical phenomena which constructs each being according to a pre-existing plan, and produces the admirable subordination and the harmonious concert of organic activity.[8]

The subject matter of general physiology has become so vast and varied that it is difficult to include it within the bounds of any single definition. The term "general" distinguishes it from "special," whether as applied to organs or species, including the human. Some have sought to identify it with cellular physiology—an idea that was rightly combated by Loeb (VI, 64), whose own definition, as identical with energetics of vital phenomena, we have already found defective. Considered as *comparative* physiology, it becomes general in proportion to the breadth of the comparison and of the common phenomena discovered, and most general in terms of those common to animals and plants, as in Claude Bernard's treatise. So conceived, it is not the exclusive possession of any one division of experimental biology.

Loeb found a great opportunity at Woods Hole, and he availed himself of it in his genial and sympathetic way. Nothing biological was alien to him. His work on physiological morphology, on parthenogenesis, on tropisms and behavior, considered in other sections of this chapter, may also be considered as in the field of general physiology. His other main lines of work at Woods Hole before his California period concerned cellular respiration; the action of acids and alkalis on protoplasm; the influence of ions of sodium, potassium,

[8] Quoted from L. J. Henderson's Introduction to the translation of Claude Bernard's *An Introduction to the Study of Experimental Medicine* (New York: Macmillan Co., 1927). (Date of Claude Bernard's original publication, 1865).

magnesium, and calcium on various vital processes; and the antagonism between monovalent and bivalent cations.

The group of general physiologists in this period of the history of the Laboratory included A. J. Carlson, who published several papers on the heart of *Limulus* and other invertebrates (VI, 2, 3, 4), Martin Fischer (VI, 32, 33), W. E. Garrey (VI, 35), W. J. Gies (VI, 36), Ida H. Hyde (VI, 42, 43, 44), F. S. Lee (VI, 47, 48), R. S. Lillie (VI, 55, 56, 57, 58, 59), Leo Loeb, working on blood of invertebrates (VI, 77, 78), E. P. Lyon (VI, 79, 80, 81, 83), A. P. Mathews (VI, 84, 85, 86), Hideyo Noguchi (VI, 112), and Torald Sollman (VI, 119). Together these workers, with Jacques Loeb, made the Marine Biological Laboratory the center of general physiology in America and spread the influence throughout the land.

9. Animal Tropisms and Behavior

Another large chapter in the scientific pioneering at Woods Hole concerned animal tropisms and behavior. The tropism theory was almost synonymous with Jacques Loeb, as far as animal behavior is concerned. Influenced by the German botanist Julius Sachs, Loeb had published, before coming to America, a little book on the heliotropism of animals and its identity with the heliotropism of plants and had also studied geotropism in animals. These studies were resumed again as soon as he settled at Woods Hole and were carried on in conjunction with studies on brain physiology and behavior in the lower invertebrates. About a dozen papers on these subjects and a book on comparative physiology of the brain and comparative psychology (VI, 67) were the products of the period before he moved to California in 1902.

Loeb attempted to show that at least a limited group of animal reactions "can be explained unequivocally on a purely physicochemical basis, namely, phenomena which the metaphysicians would classify under the term of animal 'will' " (VI, 74). The reactions in question were, of course, the tropisms, positive and negative, in relation to light, gravitation, electric currents, etc.; these were regarded as "elements which pave the way for a rationalistic conception of the psychological reactions of animals." These studies aroused a lively controversy, both in America and abroad.

Such was the approach of the general physiologist to animal behavior; that of the naturalist and psychologist was much more common in Woods Hole then. The influence of Whitman was very strong.

In his studies of leeches (*Clepsine*), salamanders (*Necturus*), and pigeons —although his principal publications deal with matters of anatomy, embryology, and evolution—he paid very special attention to their behavior during the whole course of his investigations. Very little of these observations was published; but in a notable paper on "Animal Behavior," published in the *Biological Lectures*, he summarized his observations and stated his views briefly. His attitude was well stated in the opening paragraphs:

> Animal behavior, long an attractive theme with students of natural history, has in recent times become the centre of interest to investigators in the field of psychogenesis. The study of habits, instincts, and intelligence in the lower animals was not for a long time considered to have any fundamental relation to the study of man's mental development. Biologists were left to cultivate the field alone, and psychologists only recently discovered how vast and essential were the interests to which their science could lay claim.
>
> The contribution which I have to offer aims at no extensive exposition of the subject, but rather to call attention to some phenomena which I have observed, and to connect therewith such interpretations and theoretical considerations as may come within the sphere of general biology [VI, 137].

He carried on the traditions of Romanes and C. Lloyd Morgan in England but advanced far beyond them both in method and analysis. He dealt with pure instinct as the point of departure for the study of animal behavior and considered its relation to the development of intelligence and consciousness. He rejected the habit theory of the origin of instincts and rested his own interpretation on the parallel evolution of structure and instinct and their associations in ontogeny. Physiological status, sensitivity, and internal psychic states, such as hunger and fear, were the principal factors in behavior. He referred to Loeb's theories only in a footnote, to call attention to the difference between the conception of substances determining tropisms as primary factors, and the organization of the animal secondary, in instinctive behavior, and his own conception that instinct and organization are "two aspects of one and the same thing, hence both have ontogenetic and phylogenetic development."

Whitman's interest in animal behavior coincided with the incoming tide of comparative psychology in America as well as in Europe. He invited two of the rising young American exponents to Woods Hole: E. L. Thorndike, who lectured on "Instinct" and on "The Associative Processes in Animals" (VI, 127, 128) and demonstrated some of his experiments; and R. M. Yerkes, who carried on his investigations

there for five or more years (VI, 157, 158). At the full flood of interest a separate department of psychology was organized in 1900 under the direction of Thorndike and Yerkes. An introductory course in animal psychology was announced, with lectures, demonstrations, and laboratory exercises. An advanced course was also announced. But the department was not continued thereafter. Whether directly connected with this current or more generally with speculative biology, E. G. Spaulding, philosopher of Princeton, worked at the Marine Biological Laboratory for many years and gave a widely attended course of lectures on the "Philosophical Aspects of Biology and Allied Sciences" from 1910 to 1921.

Among others who dealt with animal behavior at the Marine Biological Laboratory during this period were: G. A. Drew, on habits and movements of various lamellibranchs (his remarkable studies on reproductive behavior in cephalopods followed later); W. E. Garrey, on effects of ions and on sight reflexes; S. J. Holmes, on phototaxis and on death-feigning; H. S. Jennings, on aspects of behavior in lower animals; E. P. Lyon, on tropisms in various animals and on functions of the otocysts with reference to compensatory movements in fishes; and Raymond Pearl, on behavior of the larvae of *Limulus*.

The very extensive work of Adele M. Fielde (eighteen papers on the behavior of ants, 1901–7) must be specially mentioned. Miss Fielde devoted twelve years of her life, from 1894 to 1905, between a missionary career in China and a final career as social worker in the state of Washington, to study and research in zoölogy; the latter was devoted exclusively to ants, with special reference to sense discrimination, studied experimentally in artificial nests, which she handled with scrupulous care. Perhaps no one has made such extensive studies of the amazing powers of discrimination of these little creatures, but Wheeler says of her theory that each joint of the antenna has a special function in discrimination of odors, that "we are not sufficiently justified in regarding the ants' antenna as an organ made up of a series of specialized 'noses.' " Miss Fielde was, in any event, both a notable and gifted worker and a most entertaining and friendly character.

With the transfer of animal behavior into the hands of professional psychologists that took place gradually, beginning about the first of the century, the subject ceased to be a main field of research at the Laboratory except as carried over into the field of ecology.

10. Botany

The study of plant life has always been an integral and significant part of the activities of the Marine Biological Laboratory. It was encouraged at the start as part of the plan for comprehensive representation of the biological sciences through the interest of William G. Farlow, professor of cryptogamic botany of Harvard University, who was one of the founding fathers of the institution. In the second year, 1889, Professor Farlow attended as investigator; and J. E. Humphrey, professor of vegetable physiology at Amherst College, gave a course of ten lectures on the Algae. Plans were then made for establishing botany as a separate department on an equal basis with zoölogy; this was begun in 1890 and formally accomplished in 1891 under the leadership of W. A. Setchell.

It was clear from the beginning that, commensurate with its importance, botany could not be expected to develop proportionately to zoölogy in a marine laboratory. Although plants take the same part in the sustenance of animal life in the oceans as they do on land, the role is played mainly by unicellular forms, such as diatoms, floating everywhere in the oceans in inconceivable numbers. Multicellular marine plants are mostly "seaweeds" (Algae), which play a minor role in the cycle of life in the ocean but which, on account of their littoral habitats, variety, and beauty, offer a most attractive field of research; they are also very adaptable to physiological experiments. As a consequence, the most characteristic botanical research at the Marine Biological Laboratory has dealt with the Algae, although many botanists have been attracted there for general biological research and have brought their problems with them.

Cape Cod presents, it is true, a great wealth of aquatic and terrestrial vegetation and a variety of ecological conditions; but, when everything is summed up, Woods Hole offers fewer advantages to the botanist than to the zoölogist. Nevertheless, botany has always been strongly represented, even if by relatively small numbers, on account of its relationship to general biological science and its few special attractions at Woods Hole.

This was true at the time when the department was being established, and the impetus then given has carried through the years. It was due to the leadership of W. A. Setchell and W. J. V. Osterhout (1892–95) that the department got off to a good start. The leadership was then taken up by George T. Moore and Bradley M. Davis, who associated with themselves as investigators for longer or shorter periods

before 1908 such eminent representatives of universities as R. A. Harper, of Columbia University, B. M. Duggar, later of the University of Wisconsin, G. R. Lyman, of Dartmouth, I. F. Lewis, now of the University of Virginia, H. C. Cowles, of the University of Chicago; and representatives from the Department of Agriculture in Washington, then or later distinguished in their fields, including Walter T. Swingle, David G. Fairchild, Erwin F. Smith, and Herbert J. Webber. All these contributed, in one way or another, to the early history of botanical research at Woods Hole. Nor must we forget the devoted women, Rhoda A. Esten and Lillian G. MacRae, who started and nursed the beautiful collection of marine algae belonging to the department.

The research output in botany[9] during the early period of the Laboratory was about equally divided between algal studies and other lines. In the general botanical studies there was no consistent trend. There was some interest in toxic metals about 1903 (True and Gies, VI, 130; True and Oglevee, VI, 131; Kraemer, VI, 45). At the same time there was some attention given to the peculiar features of the local land flora, the strand plants, moraines, and reforestation (Shaw, VI, 118; Chrysler, VI, 7, 8). General cryptogamic morphology also attracted several investigators; and there were also morphological studies in fungi and bryophytes (Davis, VI, 22, 23, 24; A. C. Moore, VI, 99).

From the first, the algal studies disregarded the fresh-water vegetation; and, stimulated by Fr. Schmitz's demonstration of the significance of the female reproductive apparatus in the basic classification of the red algae (Rhodophyceae), as well as the new conception of alternation of generation in plants, there were a series of papers on the reproductive structures of the local Rhodophyceae. They began with that of Webber (VI, 132) on *Lomentaria* and culminated with those of Wolfe (VI, 154) on *Nemalion* and Yamanouchi (VI, 155, 156) on *Polysiphonia*, both of which, though now known to be imperfect in some respects, have had notable botanical influence. Studies on marine algal flora and distribution did not appear in the bibliography during this period, but Woods Hole served as a source for many of the records in Farlow's *Marine Algae of New England* (1881) and in the issues of Collins, Holden, and Setchell's *Phycotheca Boreali-Americana*. They culminated in studies on the local flora closing about

[9] The writer is indebted to the present head of the Botany department, Professor W. R. Taylor, of the University of Michigan, for the two paragraphs following.

1907, published in an account given by Davis (VI, 25, 26) and forming the botanical portion of the *Biological Survey of the Waters of Woods Hole and Vicinity* undertaken by the United States Bureau of Fisheries.

11. The Medical Sciences

The Marine Biological Laboratory has had increasingly important relations to the development of scientific medicine in America, owing to the expanding role of biological conceptions in medical education and research in the last fifty years, which may be traced back to about the time of the foundation of the Laboratory in 1888. The great advantages of contact with leaders in biological research that the Laboratory afforded, added to the fascinating biological materials available, stimulated the interest of men who were beginning, about 1890, to give their full time to preclinical subjects in the more advanced medical schools. Positions in anatomy and physiology especially were passing out of the hands of practicing physicians, and toward the end of the century were occupied with increasing frequency by men who did not have the M.D. degree, and who lived on their teaching salaries, like professors in other academic fields, and treated their subjects as sciences, no longer exclusively as practical preparation for clinical education.

Charles Sedgwick Minot, of Harvard Medical School, was one of the incorporators of the Marine Biological Laboratory and trustee for the first ten years. He was investigator at the Laboratory in 1889, though not otherwise directly concerned in its scientific work. But he is worthy of note in the early scientific history of the Laboratory because he was the first representative of a medical school connected with it and also a pioneering example of the biologist in medical education. He was not a Doctor of Medicine but a Doctor of Science. President Eliot stated[10] that his first appointment in the Medical School of Harvard University in 1880 was "procured for him with some difficulty . . . . it was an unwelcome idea for the Medical Faculty that any instruction whatever should be given in the Medical School by a person who had never taken the degree of Doctor of Medicine." He was primarily a naturalist; at first he taught histology and embryology, and finally he became director of the anatomical laboratories of Harvard Medical School.

From 1892 on, it becomes increasingly difficult to draw the line between the medical and the biological sciences at Woods Hole; but,

[10] *Proceedings of the Boston Society of Natural History*, **35**, 89, 1915.

if we confine our attention to those who either were, or shortly were destined to become, staff members of recognized medical institutions, we find that there was a steady increase in the number of investigators registered: in 1892, five; in 1895, eight; in 1902, fourteen; and in 1906, twenty. Notable among these were some destined to play important roles in the "Heroic Age of American Medicine," such as[11] William T. Councilman (1893), Simon Flexner (1894–95), Franklin P. Mall, J. Loeb, J. P. McMurrich, L. Hektoen (1900), A. P. Mathews, E. P. Lyon, W. E. Garrey, Leo Loeb, A. J. Carlson, Hideyo Noguchi (1902, 1907), and C. R. Stockard. Among the medical institutions represented up to 1908 were: Harvard Medical School, College of Physicians and Surgeons of Columbia University, Johns Hopkins University Medical School, Syracuse University Medical School, University of Michigan Medical School, Woman's Medical Schools of Philadelphia and New York, University of Kansas, University of Minnesota, University of Buffalo, University of Pennsylvania, University of Maryland, Rockefeller Institute for Medical Research, and Cornell University Medical School. These are named in the approximate order of their appearance in the records. Some of them had representatives on the Board of Trustees.

The subjects under investigation at that time attributable to the medical sciences are pretty well included in the preceding review of subjects; they fall, for the most part, in the fields of physiology, biochemistry, and embryology. But the important investigations of Leo Loeb (VI, 77, 78) and Hideyo Noguchi (VI, 112), for instance, fall, rather, under comparative pathology.

If so much interest on the part of medical schools was manifested in the given period up to 1908 when provisions for experimental biology were so primitive in Woods Hole, it was to be anticipated that the interest would become much greater after the building programs of 1913 and 1923 were completed. This expectation was amply realized.[12] Nobody draws a line any more between medicine and biology at Woods Hole. There is a perfect fraternization. One can give no exact estimation of the value of the reciprocal influences of

[11] In the case of those who were occasional, rather than regular, members of the Laboratory, either as workers or trustees, the years of attendance are given in parentheses after the names.

[12] The total number (seventy-four) of medical institutions and hospitals represented at the Laboratory from 1888 to 1941 is shown in an appendix (V, A, 1), classified by states. The number of investigators from twenty-two such institutions was forty-three in 1922 and seventy-five in 1939.

the Laboratory on scientific medicine and of the latter on the Laboratory. There can be no doubt, however, that the initiation of general physiology at Woods Hole in 1892 was significant for the early development of scientific medicine in America.

12. Conclusion

It is, of course, arbitrary to limit the account of research at the Marine Biological Laboratory to the first twenty years. To carry the account through thirty-four succeeding years of activity would involve an appraisal of the enormous diversification of experimental biology that has occurred during that time, especially in cellular biology. Such an effort would be out of place in this book. The first twenty years mark the transition from the predominantly morphological standpoints that characterized the beginning of this period in 1888 to the more analytical experimental methods that gradually succeeded. These years reflect a nation-wide and world-wide tendency in the life-sciences, a growing reliance on the more exact techniques of physics and chemistry, and a corresponding elimination of purely vitalistic conceptions as working hypotheses. The Laboratory holds no brief for any system of science or philosophy; it has, indeed, no set program beyond that of aiding in the progress of the science that it represents; its history represents a free association of all branches for which its organization is valuable.

The preceding account is incomplete not only with reference to the development of biology at Woods Hole but also with reference to the subsequent investigations of the persons concerned in the first twenty years. Most of them have made equally important contributions since (in many cases their principal accomplishments were of much later date); a few are still active; and others have joined the "great majority." They have been succeeded by much larger numbers of investigators, whose ages range from beginners to veterans, who have incomparably better facilities, and whose ardor for research and for the preservation of the principles of organization of the Laboratory burn equally bright.

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CHAPTER VII

Four Leaders

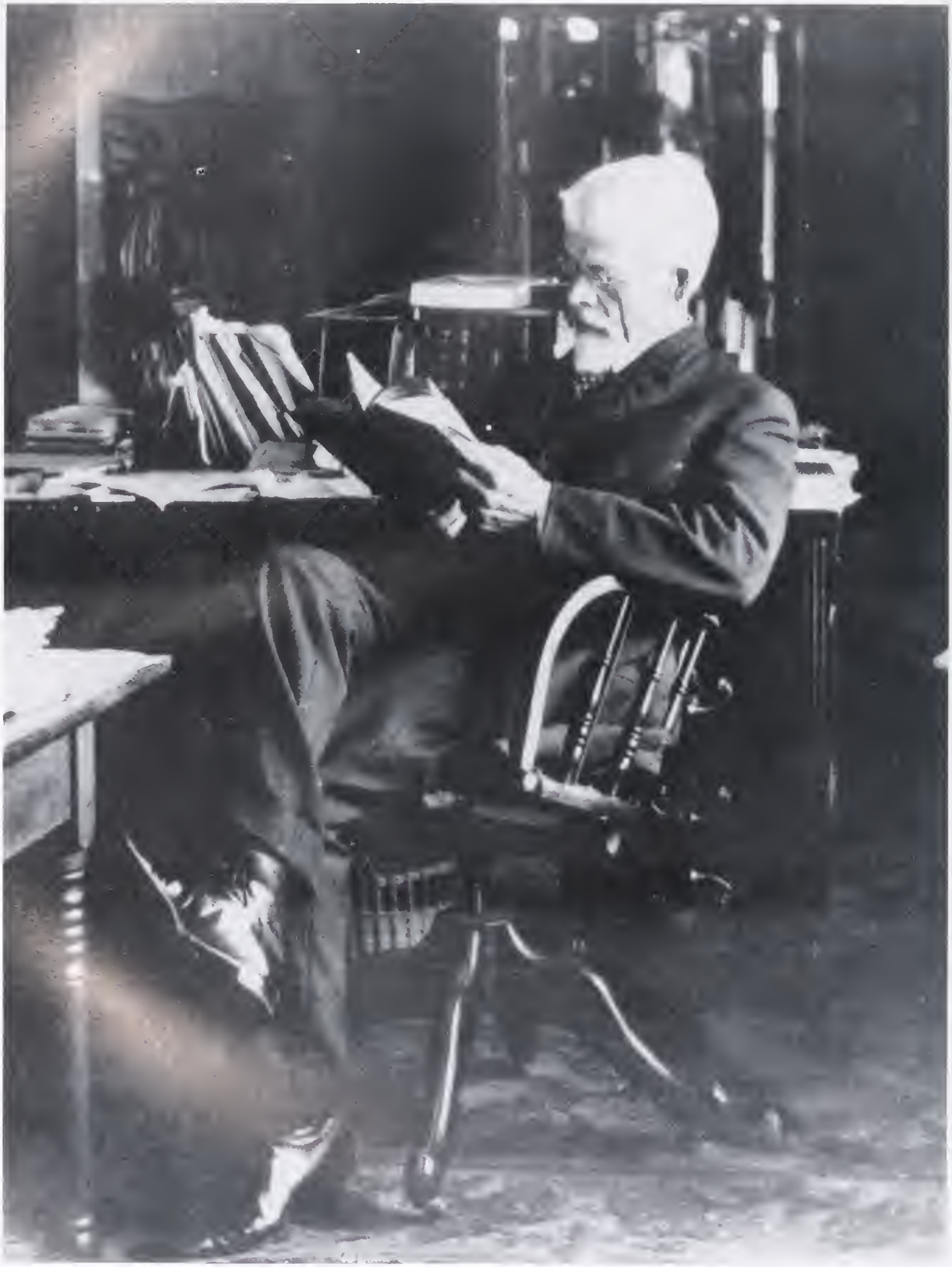
FOUR of the leaders in the development of the Marine Biological Laboratory have been selected for brief sketches that may serve to throw more light on the parts that they played in its history. In the book they appear in various acts on the stage, stepping on and going off with but slight clues as to what manner of persons they were. The sketches, purposely drawn with few strokes, should help to interpret their acts.

I. CHARLES OTIS WHITMAN, 1843–1910

By E. G. Conklin

Any history of persons connected with the Laboratory should begin with the man who, more than any other, fixed the character and ideals of the Laboratory—its first director, Professor Whitman. He was a man of striking appearance, with abundant snow-white hair, mustache, and beard, high forehead, piercing eyes, rather thick lips, wide open nostrils, erect and dignified posture, deliberate movements, and rather slow and hesitant speech. There was an air of dignity about him that prevented too much familiarity, and yet such a spirit of sincere friendliness as won all hearts. His essential kindness was seen not only with students and associates but even in his treatment of all animals. He was a simple, sincere, hospitable, and gracious friend and host.

But this gracious exterior covered an inner nature of rugged courage, determination, and persistence; a nature of high and uncompromising ideals with respect to both scientific work and personal character. In this union of grace and strength he always seemed to me a perfect example of the maxim: "Suaviter in modo, fortiter in re." His personal charm; his complete unselfishness; his sympathy, loyalty, and friendliness bound students and younger persons to him as with hooks of steel; but his uncompromising persistence in any



C. O. WHITMAN (1842–1910), ABOUT 1908

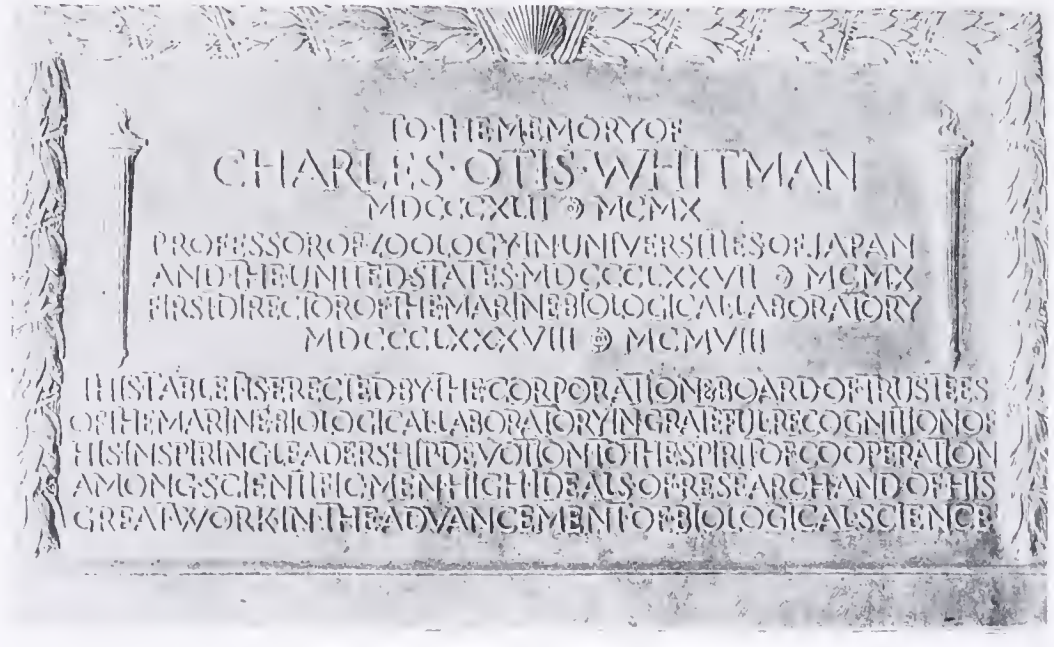
course which he held to be best often alienated those whose opposing opinions were equally strong.

He was in many ways childlike in his unworldliness, and some of his ideals seemed to take little account of the ways and means of reaching them. When a cautious realist once said to him, "Your plans would take a mint of money," he replied: "Great God, what is money for!" His enthusiasm and complete devotion to the Laboratory inspired all the younger workers, and he readily enlisted them in his plans; but older and more cautious persons, especially those with business experience, often regarded him as an impractical idealist. This led to differences with some of the members of the Board of Trustees on two occasions, as has been related elsewhere in this history; but subsequent events proved that he was right.

His personal interest in young persons and his encouragement in research work were sincere and stimulating. I can never forget my first meeting with him in 1891. E. B. Wilson had told him something of my unpublished work on the embryology of *Crepidula*, and he sent me an invitation to visit him in his laboratory. He was, to my imagination, a dweller on Olympus and I was nobody. But he treated me as if I were his equal; and, after I had explained my work, he said: "You must let me have that for publication in the *Journal of Morphology*, and you must become a member of the staff of this Laboratory." That was the first important encouragement in my research which I had received. At that time my chief adviser, Professor Brooks, had no high opinion of my work on cell lineage; and, when it was submitted to him as a doctoral thesis, he said, "This university has given degrees for counting words; I suppose it might give one for counting cells," and he added that he did not see how I could ever get it published. Professor Whitman's encouragement put new life and determination into me and was really a turning-point in my career.

My experience in this respect was like that of many serious workers at the Laboratory, hundreds of whom were inspired to long-continued work by his encouragement. At a time when some workers were "nursing the animal kingdom" and rushing from one field of research to another, he commended those who continued to work on one organism, saying that such intensive work had the greatest value. When changing scientific fashions and winds of doctrine swept through biology, he stood "foursquare to all the winds that blew." He once said that it took as much or more evidence to cause him to change his opinions as it had taken to form them in the first place.

Although he was so friendly in his personal relations with others that he would go out of his way to show kindness by invitations to dinner or a game of chess or a buggy ride, or even by accompanying to the railway station one who was leaving Woods Hole, if once he lost confidence in the integrity of a person, he was implacable. I once saw him order such a person out of his house and threaten to throw him out if he did not go at once, and he was capable of doing just that. Although he was the soul of graciousness in his relations with those whose work and character he approved, he was an unsparing critic of


TO THE MEMORY OF
CHARLES OTIS WHITMAN
MDCCCXLII ✠ MCMX
PROFESSOR OF ZOOLOGY IN UNIVERSITIES OF JAPAN
AND THE UNITED STATES MDCCCLXXVII ✠ MCMX
FIRST DIRECTOR OF THE MARINE BIOLOGICAL LABORATORY
MDCCCLXXXVIII ✠ MCMVIII
THIS TABLET IS ERECTED BY THE CORPORATION & BOARD OF TRUSTEES
OF THE MARINE BIOLOGICAL LABORATORY IN GRATEFUL RECOGNITION OF
HIS INSPIRING LEADERSHIP DEVOTION TO THE SPIRIT OF COOPERATION
AMONG SCIENTIFIC MEN HIGH IDEALS OF RESEARCH AND OF HIS
GREAT WORK IN THE ADVANCEMENT OF BIOLOGICAL SCIENCE

Courtesy of E. P. Little

WHITMAN MEMORIAL TABLET

careless or stupid work and a great hater of sham and pretense. It was often said that, although usually mild in speech, he could on occasion dip his pen in gall.

His method of training investigators was that of "learning by doing." He often set students at work on research problems before they had had any preliminary training, for he had confidence that they would get the broader knowledge if once they did thoroughly the specific task. For example, Katharine Foot came to the Laboratory in 1891 without any preliminary training in science; and, after six weeks in the invertebrate course, Whitman set her to work on the maturation and fertilization of the egg of the earthworm—a most difficult problem, which she mastered brilliantly. Other such cases could be cited.

His great influence as a teacher was due to his personal associations

with students. He was not a fluent lecturer, and he evidently avoided giving lectures whenever possible. He once said to me that no teacher should give more than one lecture a week; and, if lectures generally were prepared with all the care that he bestowed on his, that would be more than enough. His published lectures and papers were models of fine polished writing. "No less care was devoted to form than to substance, and some of his papers will endure as classics of the biology of his time" (VI, 54).

His grave in the churchyard at Woods Hole is almost within sight of the institution that he loved so well. "He rests from his labors but his works do follow him."

II. CHARLES R. CRANE, 1858–1939

By Frank R. Lillie

Charles R. Crane, the principal benefactor of the Marine Biological Laboratory, was born in Chicago, August 7, 1858. He was the eldest son of Richard T. Crane, the great manufacturer, who founded the Crane Company in 1855 and developed it from the simplest beginnings to one of the leading industries of the country. Charles was brought up during the early struggles of the company and was inducted by his father into the business while still very young, so that he received but little formal education. In spite of this, he became one of the really cultivated Americans of his time—friend of presidents, of many statesmen, both at home and abroad, of some of the most notable American university presidents, and a supporter of educational enterprises and of good cultural causes both here and in several foreign lands. He became a very distinguished interpreter of Russian, Middle Eastern, and Chinese affairs. He was noted for his many friendships and great personal generosity. Largely through holdings of Crane Company stock, he became independently wealthy while still young.

Up to 1914 he maintained an active interest in the affairs of Crane Company; he was first vice-president from 1904 and president from 1912 to 1914, when he retired. During the latter part of this time his activities were of a very general character concerning both the internal organization of the company and the external relations of the parent-organization in America and in Europe. After his father's death he and his brother, R. T. Crane, Jr., established large pension funds for employees and for their widows and children. The welfare

of employees was always close to his heart; and he maintained close, friendly relations with many of them.

When he was about nineteen years of age, his health became a matter of concern to his family; and he proposed to improve it by a trip around the world. Seeing a fine merchant sailing ship in the harbor of New

C. R. CRANE (1858–1939)

York, he introduced himself to the captain and, with a charm of personality that never left him, persuaded the captain to take him as sole passenger on a trip around Africa to the islands of the East and to China. On board he studied navigation and often served as helmsman. Throughout his life he maintained a lively interest in sailing and in the history of navigation. He left the sailing vessel in China and returned by way of Constantinople, where he made lifelong friends.

This was the first of many voyages; it set the pattern for his interest in China and the Near East; Russia was a somewhat later love. So assiduously and intimately in later journeys did he cultivate these interests that he became a recognized authority, by virtue of his many friendships in these regions and his sympathetic understanding of their problems. President Wilson appointed him as member of a special diplomatic mission to Russia in 1917, to China in 1918, and as one of the American commissioners on mandates to Turkey in 1919, with special emphasis on the tangled affairs of Syria and Palestine. He was appointed American minister to China in 1920 and served one year.

His relations to the Marine Biological Laboratory have been described in Chapters III and IV. To this there is nothing to add. He did a finished job and resigned as president of the corporation in 1926 only when he was fully assured that the future of the institution was secure.

III. GILMAN A. DREW, 1868–1934

By Frank R. Lillie

Drew was born in Newton, Iowa, November 15, 1868, of sturdy farming stock; he graduated from the State University of Iowa with the degree of B.S. in 1890. After a year of teaching, he went to the Johns Hopkins University as a graduate student under W. K. Brooks; then resumed teaching in Iowa. At that time he married Lena Slawson of his home town; they remained childless throughout their long married life.

Returning to Johns Hopkins University in 1896, he received the Adam T. Bruce fellowship the next year and attained his Ph.D. degree in 1898. He remained there for two years more as assistant in zoölogy and was then appointed professor of biology at the University of Maine, where he remained until 1911.

He became connected with the Marine Biological Laboratory in 1901, at the age of thirty-three; and for the next twenty-five years, at the end of which time the state of his health demanded retirement to his citrus ranch in Florida, he was the most indispensable of all its officers. He was head of the course in marine invertebrate zoölogy from 1901 to 1907 and of embryology from 1908 to 1914. In 1909 he was appointed assistant director on part time, and in 1911 on full time; thereupon he resigned his position in the University of Maine and became a resident of Woods Hole. He was a very accomplished and

enthusiastic naturalist and an excellent teacher; to these qualifications and gifts he added a remarkable talent for administration and the practical side of laboratory management, which had full scope during the great period of development of the institution from 1912 to 1925. The laboratory buildings that were erected during this period and important features of their design and equipment are a monument to Drew as well as to the architects.

G. A. DREW (1868–1934), ABOUT 1924

This unusual combination of the scientist and teacher, who knew all the requirements to be satisfied, and of the practical man, well acquainted with the possibilities of materials, was the secret of the adequacy of the construction of the Crane laboratory for all its purposes. When the larger building program was undertaken in 1923, the model furnished by the Crane laboratory required little alteration.

Prior to 1913 the Laboratory had been indebted to the Bureau of Fisheries for its supply of circulating sea water and the use of its wharves—services of great importance which were reciprocated in every way possible. But when demands became greater with the

construction of the Crane building, it was incumbent upon the Laboratory to furnish its own services. For the supply of sea water it was especially important that the pumping site should be free from contamination and that all brass or other metals likely to introduce poisonous salts into the water should be eliminated from the piping system. To secure these results, Drew made a study of tidal currents along the water frontage and of the the rate of renewal of the water; a bacteriological examination was also made; and finally there was conducted an elaborate study of the toxicity of sea water after retention of piping metals in it for measured periods of time. These studies led to the determination of the location of the pumping station and to the decision to use nothing but lead and rubber in the pumps and piping. The favorable results have already been mentioned (p. 108). This is cited as an example of the painstaking care that Drew devoted to all problems of construction and equipment.

Outside his varied activities as teacher, administrator, and laboratory engineer, Drew was able to devote considerable time to the continuation of his own studies during his residence in Woods Hole. His interests were those of the naturalist rather than those of the experimenter. He knew the habits and habitats of the animals that he studied and their behavior, especially with reference to modes of reproduction. He was an excellent anatomist and draftsman, illustrating his observations with his own pen and brush. Some of his publications have already been mentioned (pp. 122, 143).

In his childhood Drew had met with an accident that crippled one leg, leaving it somewhat shriveled and short. His crutch had a step for the shriveled leg, but the other leg was as powerful as two. There was nowhere that others went that he did not also go—on excursions over rocks and boulders, in construction work up and down ladders and along platforms. He was both vigorous and skilful. He was tall and well nourished, with fine, strong features, as his photograph shows.

Drew was upright and conscientious almost to a fault; he was a good deal of a puritan and did not drink or smoke. While he was not in the least self-righteous, he was uncompromising in regard to all breaches of the strictest honesty or moral standards, a quality that sometimes brought him into conflict with a few members of the community; but with others he was on friendly, helpful terms. He retained to his life's end the simple, democratic attitude acquired in the rural midwestern community in which he had been brought up, together with some manners and habits of speech acquired there. With him and his

wife, hospitality was both a virtue and a privilege. Altogether, he was a very notable and important figure in the history of the Marine Biological Laboratory.

IV. EDWARD GARDINER GARDINER, 1854–1907

By Frank R. Lillie

Gardiner was one of the original incorporators and trustees of the Marine Biological Laboratory in 1888 and served the Laboratory as trustee and in various other capacities until the time of his death. He was well known, indeed, to workers at the Laboratory, especially during the first fifteen years of its history, which were turbulent ones. Tall, stout, bald—he was physically conspicuous. But more marked was his devoted loyalty to the organization, which took precedence over that to his old associations in Boston—a decision that cost him the loss, at least temporarily, of some earlier friendships. He and William T. Sedgwick, of the Massachusetts Institute of Technology, were the only original members of the Board of Trustees who remained to support the Laboratory after the clash of 1897 (p. 45); and after 1900 Gardiner alone remained of this group. In 1892 he retired from the instructorship that he had held at the Massachusetts Institute of Technology, and thereafter the Marine Biological Laboratory received the full measure of his devotion. He was a man of independent means who asked only to serve.

Edward Gardiner Gardiner traced his descent to a George Gardiner who settled in Aquidneck, Rhode Island, the site of the present town of Narragansett, in 1665; a great-grandson moved to Boston about 1750, where the family was thereafter established. Edward was educated at the Boston Latin School; but, at about the time he was ready to enter Harvard, trouble with his eyes prevented immediate further study. He became acquainted, at that time, with Alpheus Hyatt, curator of the Boston Society of Natural History and professor of zoölogy and paleontology at the Massachusetts Institute of Technology, who was destined later to become the first president of the corporation of the Marine Biological Laboratory. He assisted Professor Hyatt in sorting specimens at the Museum of the Society and accompanied him on several scientific expeditions.

When his eyes were sufficiently improved, he entered the Massachusetts Institute of Technology to pursue under Hyatt the study of zoölogy, which had become his chief interest; and he graduated from

E. G. GARDINER (1854–1907), ABOUT 1898

there with the degree of Ph.B. in 1882. He then went abroad and studied with Leuckart at the University of Leipzig, where he received the degree of Ph.D. in 1884. On his return he became one of the first students at Annisquam with Hyatt, who had inspired him to enter on a scientific career and to whom he was warmly attached. His short career as assistant and instructor at the Massachusetts Institute of Technology began also immediately after his return to America. Here he was associated with W. T. Sedgwick, professor of biology, also one of the incorporators and original members of the Board of Trustees of the Marine Biological Laboratory.

It will thus be seen how early were Gardiner's associations with the events that led up to the establishment of the Marine Biological Laboratory and how natural it was for him to exhibit a certain possessiveness in his relations to it. There was a complete transfer of loyalty to the new institution that never wavered; and he consented, nearly always, to be guided by the director, Dr. Whitman. He was investigator at the Laboratory in 1888, instructor from 1889 to 1891, and thereafter functioned as clerk of the corporation and secretary of the Board of Trustees for many years, as related in previous chapters and in an appendix (V, A, 7).

Gardiner always maintained his interest in research on the acoelous turbellarians, which he began with a study of fertilization and cell lineage soon after his arrival in Woods Hole (VI, 34*a*, 34*b*). He was generous in sharing his collections with his scientific friends; as a single example, Dr. Conklin informs me that, after he had expended time and money in vain trying to get material for the study of the embryology of brachiopods, Dr. Gardiner generously gave him a complete series of the eggs and embryos of *Terebratulina* which he had collected.

There are many pleasant memories of Gardiner in the early days: his love of the boats, to the management of which he brought the experience gained in his marine expeditions with Hyatt; his piloting of the little laboratory steam launch "Sagitta" on the hazardous voyage from Boston all the way around Cape Cod to Woods Hole before the days of the Cape Cod Canal; his famous, nearly disastrous, race of the "Sagitta" with the steam launch "Cygnet" of the United States Fish Commission station in 1892; his conferring the nautical name of the "Mess" on the Laboratory eating-house, which provoked the interesting remark from one of the trustees from Boston, a lady, who on inspecting the place exclaimed, "So here is where you have your

messes!" his generosity to younger investigators and friendly relations with them; his horseback-riding in earlier years; his home that he built on a hill overlooking Buzzards Bay after his marriage in 1895, which was the first of numerous summer homes built by biologists in Woods Hole; and the hospitality that he and Mrs. Gardiner exercised there, especially the famous annual luncheons for the Board of Trustees.

After the revolution of 1897 he persuaded his friend, D. Blakely Hoar, of Boston, to assume the thankless task of treasurer of a constantly depleted bank account, a man whose integrity and reputation in Boston did much to preserve confidence when most needed. He also brought to Woods Hole, John Hubbard, a gifted amateur photographer and connoisseur of fine apparatus, who lent his leisurely services to the institution.

A memorial bronze tablet in the Laboratory bears the following inscription:

EDWARD GARDINER GARDINER
Zoölogist
Incorporator of the Marine Biological Laboratory
and member of the original Board of Trustees
For many years Clerk of the Corporation and
Secretary of the Board of Trustees
A man whose fine sense of honor and loyalty
shone in his deeds.
A scientist to whom the success of this institution
was the fulfilment of his life interest.
1854 – 1907

CHAPTER VIII

Community Life

By E. G. CONKLIN[1] and FRANK R. LILLIE

THE history of the Marine Biological Laboratory would be very incomplete without some record of its notable community life. While the Laboratory is officially and actively a scientific institution, it is, above all, a community of scientific workers, their families, and their associates. Here they live together in the delightful relationships of friends and fellow-workers, free from the artificial conventionalities of society and almost wholly free from the suspicions and jealousies that are sometimes found in small communities. This is due partly to the fact that there are no competitions for positions or salaries at the Laboratory and partly to the fact that the community is large enough to preclude the necessity of daily contact with persons one does not like. There is also a striking lack of jealousy, suspicion, and fear of losing priority in scientific work. At the great Naples Station, at one time, printed instructions requested workers not to discuss their discoveries with others. At Woods Hole, on the contrary, there has always been frank and free discussion of work in progress, not only among individuals but also in public lectures and seminars; and one rarely, if ever, hears that such confidence has been abused. Furthermore, there is no attempt on the part of the officers of the Laboratory to direct or control the work of investigators, every person being free to work on his own problem in his own way and to publish his results as he may see fit. This is in striking contrast to the customs of some European laboratories. A visitor from one such institution inquired: "Who determines the research program of this Laboratory?" "Who assigns the different problems and directs the work on them?" "Who decides when and where the results shall be published?" When he was told that there was no such direction and supervision at Woods Hole, he seemed astonished and then said: "Well, this must be a heaven of freedom."

[1] Pp. 170–74.

The relative lack of secrecy about work in progress at the Laboratory and of fear of losing priority of discovery has often been commented on by visitors. At other times and places, struggle for priority has often developed into bitter personal antagonism—witness the fight between Lankester and Fol, or that between Cope and Marsh, or many other such private wars. Such antagonisms have been almost wholly lacking at Woods Hole, where the spirit of frank and open discussion has grown with the intimate association of workers. It is more difficult to quarrel with those you know well than with strangers, and the influence of this Laboratory in promoting peaceful co-operation in biology is one of its major by-products.

On the other hand, such friendly associations have not destroyed that wholesome spirit of criticism which, in the words of Claude Bernard, is the life of science. Nowhere is scientific criticism more frank than among associates at the Marine Biological Laboratory; but, in general, it is criticism of methods, conclusions, and interpretations rather than of persons. But this does not mean that judgments of scientific and personal qualities are lacking; on the contrary, there is probably no large scientific society anywhere where the opportunities are so good of forming just opinions of the personal and professional qualities of scientists. For this reason, administrators of educational and scientific institutions find Woods Hole a happy hunting ground for the opinions of leading biologists regarding the qualifications and personalities of candidates for official positions. The Laboratory has become a clearing house not only of biological research but also of biologists: it has a supply department for biological "material" and an equally important one for biological investigators.

All science is a social function, in that it is dependent upon co-operation. Every advance in knowledge is built upon that which has gone before. Every worker is indebted to other workers. Comparison, confirmation, or criticism of the work of others enters into all scientific progress. This co-operative aspect of science is promoted not only by publication and occasional meetings of scientific societies but especially by living and working together in laboratories such as this. Biologists are peculiarly favored, in that much of their work takes them into the open during the summer. Many scientists in other fields, such as physics, chemistry, and psychology, have lamented the fact that they have no Woods Hole, which combines so admirably the features of research, conference, and recreation.

Our community life is especially strengthened by residence in the

dormitories and apartment house, eating together in the "Mess," evenings of music, singing, and dancing at the clubhouse, tennis on the Laboratory courts, boating parties and picnics, and the ever popular bathing at the Laboratory beach, Lillie's pier, or the Gansett beach. Many of the more permanent workers at the Laboratory have bought or have built houses in the village or in the Gansett tract of 21 acres adjoining the village on one side and the golf course on the other, which was bought by the Laboratory. Already thirty-seven houses have been built by Laboratory workers in this beautiful, wooded tract, and about as many more along the shores of Buzzards Bay and the Mill Pond and on the slopes of Crow Hill or in the village. There are at least seventy-five families of biologists who are regular summer residents of Woods Hole, while the apartment house and dormitories accommodate about three hundred of the more or less occasional workers and their families.

Family life not only contributes to the pleasure of life at Woods Hole, but Woods Hole has contributed amazingly to family life. Most of the seventy-five families that own their summer homes there, and many others scattered far and wide, had their start in romances which began at the Laboratory. The writer had intended to give a list of some of the most famous of these matches; but, after having found the number of these partnerships for life longer than the Catalogue of Ships in Homer, he realized that such a list would necessarily be incomplete and that omission from such a happy catalogue would be a cause of grave offense. Perhaps it is enough to say that the Marine Biological Laboratory is a famous institute of practical eugenics. If "marriages are made in heaven," there is certainly a large branch office in Woods Hole; and these Woods Hole marriages are almost invariably heavenly, for they are unions of those of like minds and tastes after intimate acquaintance and companionship and are therefore enduring. And, as might be expected among biologists, they are generally eugenical as to offspring. A parade of ribald students at one of the men's colleges carried a transparency reading: "To Hell with Eugenics! We want Love!" At Woods Hole they have both! And there is probably no place on earth where children have a happier and healthier time.

Owing to the lack of boarding places in the village when the Laboratory was started, it was necessary to provide a commons for all workers. This was given the nautical name of the "Mess" by Dr. E. G. Gardiner. During the first two sessions it was located in a private

house at the head of Little Harbor, which was loaned by Miss Fay; later it was situated in the "Homestead," across the street from the residence of the United States Bureau of Fisheries. Still later, a large Mess Hall and kitchen were built at the corner of Water and West streets, on land which had been acquired by the Laboratory. In March, 1920, this building was destroyed by a fire which originated in the power plant of the United States Bureau of Fisheries across the street; but it was at once replaced by the present, enlarged and more complete Mess Hall. Here as many as three hundred persons are fed at one time, and it may be said to be the center of the social life of the Laboratory. Until 1915 the price of board was kept at the low figure of $5.00 a week; but, with the increased cost of food during the first World War, it was necessary to raise the price to $7.00 a week; and it is now, in the second holocaust, $8.00, which is much less than is charged elsewhere. The food is plain but good and abundant; and the service is unusually intelligent, the waiters and waitresses generally being workers at the Laboratory or college students.

These bare facts regarding the "Mess" tell nothing of the spirit of intimate association and jovial fellowship that prevails there. One needs to see and experience these meetings, three times a day, on the veranda surrounding the hall and at the many tables within to realize what an important feature it is in the social life of the Laboratory. Here, more than anywhere else, the social life centers. The bulletin boards at the entrance carry announcements of sports, picnics, concerts, lectures, etc. The lively conversations at many tables are usually gay, but sometimes serious and critical. The writer well remembers his first summer at the "Mess" in 1891, when Whitman sat at one of the tables reserved for the staff and Ayers at the other; the arguments between the two regarding the metamerism of head or nerves or sense organs often waxed fast and furious. Such violent discussions now seem antiquated and are generally avoided in the preservation and promotion of good temper and digestion. Of late, Dr. George H. Parker has instituted the custom at his table of imposing a graduated scale of fines for violations of a mutually imposed code of decorum, covering many things, from tardiness and making spots on the tablecloth to emotional arguments and assertions that ou[illegible] run evidence. The coins thus forfeited are placed in a pot at the center of the table; and, when it is nearly full, the table decides how to spend it. Not all tables are as decorous as this; the spirit of the "Mess" is rather one of free and easy fellowship. Many a worker at the

Laboratory remembers his table companions at the "Mess" and their conversations as among his most enjoyable experiences.

Another social organization that contributes to the pleasure and profit of the workers is the M.B.L. Club, which has a building of its own on the water front overlooking the harbor. This building was once the home of the Woods Hole Yacht Club; it was later bought by Mr. Crane and presented to the Laboratory. Here are current newspapers, magazines, and popular books, a phonograph, ping-pong and card tables; and here, once or twice a week during the sessions, are held dances, receptions, and musical programs. Membership is open to all persons in the Laboratory and their families on payment of a nominal fee of $1.50 a year.

The Choral Society is a well-established organization of people connected with the Laboratory who meet for choral practice once a week and give a public concert at the close of the season. For a number of years this work was under the skilled and enthusiastic direction of Professor Serge Gorokoff, of Smith College. There are also occasional dramatic performances by students and staff, as well as other entertainments and popular lectures—all of which give variety and spice to the serious work of the Laboratory.

In addition to these indoor activities and outranking all of them in popular appeal are the outdoor sports, recreations, and adventures. It should not be forgotten that the regular sessions of the Laboratory occur "in the good old summer time," when people of many other professions are off on vacations, and it is one of the advantages of Woods Hole that it is possible to combine in such admirable manner both work and play, vocation and vacation.

Of all recreations, sea bathing is probably the most popular. Boating and sailing come next; and the picnics to distant beaches or the Vineyard, and the sailing races and regattas, afford not only sport but also much adventure. Tennis courts are maintained by the M.B.L. Tennis Club, and they are occupied at almost all hours of the day by enthusiastic, if not always skilful, players. Tournaments are held toward the end of the session, and in the finals and semifinals one sees some good playing. Golf is another sport in which others participate; and the Woods Hole Golf Course is one of the finest on the Cape, but the dues or fees keep many of the poor biologists away except before or after regular playing hours, when the splendid views from Mowing Hill attract those who would rather keep their eye on the Sound or the Bay than on the balls.

Professor J. McKeen Cattell furnishes the following reminiscences[2] of "The Woods Hole Laboratory in the Old Days":

A recent visit to Woods Hole revives memories of the unreturning past. In the nineties and the early years of the present century there worked in the laboratory through the summer, or came as visitors, a group of biologists not paralleled in any other institution or in any other science. The workers included Whitman, Wilson, Conklin, Morgan, Loeb, the Lillies, Jennings, Parker, Kingsley, Stockard, McClung, Grave, Curtis, Calkins, Crampton, Treadwell, Child, Metcalf, Andrews, Knower, Strong, Montgomery, Ayers, Drew and others, distinguished alike for their scientific research and in their personal qualities. The regular visitors included Osborn, Wheeler, Harrison, Davenport, Abel, Mall and many others.

I am no marine biologist, but in the remote past spent four summers at Woods Hole and have since been a yearly visitor, usually for a day or two. There were also later other psychologists there, including Thorndike, Yerkes and Warren. My seven children followed the graduate course in invertebrate zoölogy before any of them had attended any school, except one who was a college freshman.

. . . . . .

Woods Hole, situated between Buzzards Bay and the open sea, is an attractive place, but its great charm was in the people who were there and the unsophisticated life they led. Memorable are talks over the laboratory tables or far into the night, and, as has been remarked, if marriages are made in Heaven, Woods Hole is a branch office. It was all simple and fine—wooden sheds for laboratories and a budget of $6,000. But what interested me most of all was that it was an institution for scientific research, owned and conducted by scientific men. The Corporation consisted of biologists and others interested in the laboratory and the Trustees elected by them were nearly all scientific men working in the laboratory and representing different universities.

Such an organization is likely to give rise to loyalty, self-sacrifice, quarrels and poverty; a professor in the University of Moscow once told me that they formerly had a philosophical club, but that it was necessary to disband it because they were so much interested in philosophy. When I inquired how that could be he explained that they usually came to blows about three o'clock in the morning. At Woods Hole there may have been vigorous disputes as to whether a lobster is red, but we never came to blows about it.

Formerly there were three orders of society in Woods Hole, disrespectfully referred to as the "natives," the "dudes," and the "bug-hunters," in the order of their establishment there, but with accretions to each order through the years. These names have disappeared, symptomatic of better understanding through various forms of interpenetration.

In the early years the scientists were somewhat of a puzzle to the permanent residents. There were many "doctors" among the scientists, of course; but they were not real doctors, only "bug-doctors,"

[2] Chapter concluded by F. R. L.

whose ways were mysterious in their indiscriminate interest in all sea animals, whether edible or not. There is the story of the tall carpenter, builder of many homes of biologists, who encountered Professor E. B. Wilson long ago while the latter was examining some ditches driven through a swamp for the purpose of reducing a plague of mosquitoes. Noticing the carpenter's interest, Professor Wilson explained the project in his lucid way; and the carpenter, who towered over him, bent down and remarked: "Wall, I swan! If you little fellows haven't more in your heads than we ever gave you credit for!" The Laboratory has for many years employed residents in its collecting department and other services, and they have acted as interpreters to townspeople, so that gradually there has arisen a better understanding of what it is all about.

As the scientific community enlarged and the children were growing up, a summer school of science was established for them, under the leadership of mothers in the scientific community. The town furnished the use of the village school; subscriptions of members provided teachers; admissions and time required were elastic. The school has been in operation for thirty years and has served not only to give useful and interesting occupation to children of the community in their long vacation but also to draw together members of the community and interpret the Marine Biological Laboratory to them.

Mrs. Frances Crane Lillie also presented to St. Joseph's Catholic Church a beautiful bell tower on the Eel Pond opposite the buildings of the Laboratory. Designed by Charles A. Coolidge and built of granite blocks hewn from native glacial boulders, its bells ring out the Angelus three times daily. It is set in a garden belonging to the church and contains reduced replicas of Faggi's stations of the cross and a small collection of religious books.

In the village churchyard, family burial lots of biologists are to be found among those of the forefathers of the village—witness of the nostalgia of university families whose children grew up together in the freedom and delights of many summers in the small seaside community and away from the restrictive social environments of large cities.

CHAPTER IX

The Woods Hole Oceanographic Institution

I. Foundation

UNLIKE the Marine Biological Laboratory, the Woods Hole Oceanographic Institution, its sister-institution, sprang full fledged into existence. However, it had a rather prolonged period of incubation. The project for the establishment of an oceanographic station on the east coast of the United States originated in conferences beginning in 1924 between Wickliffe Rose, then president of the General Education Board, and the director of the Marine Biological Laboratory. While concerned at first with the interests of biology in general, the discussions later turned to the further development of the Marine Biological Laboratory, with the results previously stated (pp. 78, 80, 103), and in 1925 they focused on the subject of oceanography. During this year Dr. Rose visited various marine laboratories on both the eastern and the western coasts of the United States and of Canada and formed very definite opinions concerning the need of organizing oceanographic research in this country.

These matters were discussed in a conference between Dr. Rose and the writer in the latter part of 1925 and also by correspondence, resulting in a definite plan, which Dr. Rose talked over with John C. Merriam, president of the Carnegie Institution of Washington, and Vernon L. Kellogg, chairman of the National Research Council. It was then decided that the appointment of a Committee on Oceanography by the National Academy of Sciences to consider the entire subject broadly would be the best method of progress. After considerable waiting for conditions to become favorable, the matter was first presented to the Academy in April, 1927, and the following motion was then unanimously passed: "That the President of the Academy be requested to appoint a Committee on Oceanography from the Sections of the Academy concerned to consider the share of the United States of America in a world-wide program of Oceanographic Research and report to the Academy."[1]

[1] *Annual Report of the National Academy of Sciences, 1926–1927.*

The president of the Academy, A. A. Michelson, thereupon appointed the following committee: William Bowie, of the United States Coast and Geodetic Survey; E. G. Conklin, of Princeton University; B. M. Duggar, of the University of Wisconsin; John C. Merriam, of the Carnegie Institution of Washington; T. Wayland Vaughan, of the Scripps Institution of Oceanography, La Jolla, California; and Frank R. Lillie (chairman). Subsequently, Henry B. Bigelow, of Harvard University, and Arthur L. Day, of the Carnegie Institution, were added to the membership of the committee.

After a preliminary meeting of the committee, in which the general direction of its work was discussed, the Executive Committee of the National Academy of Sciences, on request of the Committee on Oceanography, approved the recommendation of the latter that they be authorized to secure funds for prosecution of their study. Application was accordingly made to the General Education Board through Dr. Rose and Dr. Abraham Flexner for an appropriation of $75,000, to be made to the National Academy of Sciences for the work of the committee. The application received favorable action on June 8, 1928. In taking this action the General Education Board was guided also by an understanding, informally arrived at some months previously between Dr. Rose and the writer, as to limits of the final cost of establishing a central oceanographic institution on the Atlantic Coast, if such an establishment should be recommended by the committee.

The really serious work of the Committee on Oceanography began with a series of conferences held at the Marine Biological Laboratory in Woods Hole between July 28 and August 25, 1928. The purpose of the conferences was to acquire information concerning the present status and problems of oceanographic research, especially in Europe and America, and to lay the ground for a study of the best ways in which to supplement American agencies. Professor H. U. Sverdrup, oceanographer of the Geophysical Institution of Bergen, Norway, who possessed wide experience in the problems of oceanography and knowledge of the European agencies and activities, was specially invited to attend and to give the committee the benefit of his advice on the problems before it. Others invited as guests of the committee included representatives of the Biological Board of Canada and of their Atlantic Biological Station at St. Andrews, New Brunswick; the Mount Desert Island Biological Laboratory; the Museum of Comparative Zoölogy at Harvard University; the Bermuda Biological Station; the United States Bureau of Fisheries; the Hopkins Marine

Station of Stanford University at Pacific Grove, California; the Scripps Institution of Oceanography at La Jolla, California; and the United States Coast and Geodetic Survey. Ten or more universities were also represented in the conferences. There were many reports and discussions, both formal and informal. The result was to furnish a clear picture of the problems before the committee.

Dr. Henry B. Bigelow, of Harvard University, was thereupon invited to devote his full time for a period of one year to making investigations on behalf of the committee and assembling material for its report. His acceptance assured sound and rapid progress and incidentally involved Dr. Bigelow in the whole future of the Woods Hole Oceanographic Institution. Largely through his efforts, the committee was able to make a preliminary, though extensive, report to the Academy in November, 1929. Part of the report was subsequently published by Dr. Bigelow under the auspices of the National Academy of Sciences in the form of a book, entitled *Oceanography, Its Scope, Problems and Economic Importance* (II, 1).

The report to the Academy is of special interest in the present connection because it contained the first specific recommendation of the committee, viz., the establishment of a well-equipped oceanographic institution in a central location on the Atlantic Coast. Out of this recommendation the Woods Hole Oceanographic Institution grew. This, however, did not complete the work of the committee. Other projects successfully completed with the advice and support of the committee included: the expansion and stabilization of the Bermuda Biological Station for Research, toward which the Rockefeller Foundation contributed £50,000; the establishment in Puget Sound of the Oceanographic Laboratories of the University of Washington; and the erection of Ritter Hall, of the Scripps Institution of Oceanography of the University of California, located at La Jolla, California. The committee also commissioned Thomas Wayland Vaughan, of the Scripps Institution, to prepare a report on "International Aspects of Oceanography" and financed his trip around the world for the necessary studies. His extremely valuable report was published by the National Academy of Sciences in quarto form in 1937 (II, 6). A report on the subject of "Oceanography in Universities" was also prepared for the committee by Dr. T. G. Thompson of the Oceanographic Laboratories of the University of Washington and presented to the Academy. On its own recommendation the committee was discharged by the Academy in 1938.

To resume the account of the foundation of the Woods Hole Oceanographic Institution: Dr. Rose, on whose interest and initiative the project had so largely depended, reached the age of retirement in 1928. As noted previously, Dr. Rose and the writer had reached an informal understanding in 1927 as to the limits of cost of establishing and maintaining a central oceanographic institution on the Atlantic Coast. The estimate made at that time ($3,000,000) was the sum finally provided. Dr. Rose realized then that this would be among his final projects; his heart was fully set upon it, as evidenced repeatedly in his conversations, and he made arrangements that its consideration should be continued without interruption after his retirement. This involved transfer of the project from the General Education Board to the Rockefeller Foundation, and the subsequent proceedings were conducted through Dr. Max Mason, director of the Division of Natural Sciences of the Foundation, who became president of the Foundation soon after.

During 1929 events moved rapidly toward realization of the plan. While the Committee on Oceanography still had to complete its large report to the Academy, which, if approved, was to form the basis of appeal for funds from the Rockefeller Foundation, architects prepared plans, and discussions proceeded with the president of the Rockefeller Foundation. It was not even decided at the beginning of the year that the site of the proposed station should be at Woods Hole; alternative locations were considered; but before the end of the summer, Woods Hole, which had from the first been regarded as the most likely site, was definitely selected, on account of its geographical advantages and the scientific good will and co-operation assured there.

Dr. Bigelow's draft of the report of the committee, begun in October, 1928, was submitted, section by section, to the members for editing and was finally approved and submitted to the Academy in November, 1929. The long report, of 163 mimeographed pages, concluded with the following recommendations, which were approved by the Academy:

Recommendations to accompany the Report of the Committee on Oceanography of the National Academy of Sciences as submitted to the Academy, November 18, 1929.

The outstanding feature of the oceanographic situation in the United States of America is that we face about equally on two great oceans, the Atlantic and the Pacific, each of which presents, in addition to the universal problems of the ocean, certain problems either peculiar to it or capable of more ready attack within it. Neither can be regarded as more important than the other from the point of view of oceanographic research. In the development of oceanography in America, therefore,

equal attention should be paid to the needs of research from the Eastern and from the Western coasts.

In the preparation of the report herewith submitted to the Academy it has been possible to obtain a reasonably complete and clear picture of the present status of oceanographic research throughout the world, which would not be materially improved by farther study. The question of the requirements for the best development of oceanographic research in America, however, presents such a complex of factors, including the utilization of educational facilities in the universities, the creation of new agencies, and the correlation of all existing agencies in America with one another and with those of other countries, that no approach to completeness in the treatment of recommendations is now attempted. The following recommendations therefore concern only steps now clearly seen to be necessary for the furtherance of oceanographic research in America. They are presented with the understanding that the Committee desires to make additional recommendations at a future time.

On the Pacific coast the conditions and outlook for oceanographic research are at present better than on the Atlantic, owing to the activities of the Scripps Institution of Oceanography of the University of California located at La Jolla. The expanding needs and well considered program of future work of this institution, however, demand and should receive additional support at an early date. Oceanographic research on the Pacific coast is also aided in an important way by the recent additions to the program of the Hopkins Marine Station of Stanford University, located at Pacific Grove.

On the Atlantic coast the existing situation renders it desirable to center attention on the development of such a type of institution as would most fully meet the needs for oceanographic work in that region. At the present time there is no institution on the Atlantic coast committed to comprehensive oceanographic investigation, even though numerous agencies are concerned with various isolated aspects of the subject as parts of more immediate programs. There is need, therefore, on the Atlantic coast, of a new organization committed to oceanographic investigation as its exclusive field; and this seems to the Committee to be the greatest need at the present time, both from the point of view of American Oceanography and also for adequate participation of this country in a study necessarily international.

A single well equipped oceanographic institution in a central location on the Atlantic coast is needed to supply necessary facilities for research and education, hitherto lacking, and to encourage the establishment of oceanography as a university subject. Such a central institution would contribute to the advancement of oceanographic research not only by the productivity of its staff but also by the impetus that it would give to studies in this field in various universities. The proposed institute would also serve a most important purpose by providing facilities for visiting investigators, and by co-ordinating the scattered interests of numerous governmental agencies and private organizations already active in parts of the field.

The central institution should be supplemented as soon as possible by two branch stations, one sub-arctic and the other truly oceanic in location. The latter location would be served admirably by the Bermuda Biological Station for Research, Inc., which has the support of the Committee in its efforts to complete its organization.

On account of the fundamental significance of oceanographic research for the world sciences of geophysics and biology, and also on account of the immense economic

interests involved, the Committee believes that the establishment and endowment of an Atlantic Oceanographic Institute should be realized at the earliest possible moment. The present time also seems to be favorable for insuring the success of such an undertaking.

Before this action of the Academy, on November 13, 1929, the trustees of the Rockefeller Foundation granted authority to the Executive Committee of the Foundation to aid in the construction and support of the proposed central Atlantic Oceanographic Institute in case the report of the Committee on Oceanography should be adopted by the Academy and the project should be entered into. The latter requirement presupposed incorporation. This matter was then discussed on November 20, 1929. At this conference it was agreed that the Marine Biological Laboratory should furnish a site for the Institution and that the Committee on Oceanography should form the nucleus of a Board of Trustees, to which additional members, including a minority of men of affairs, should be added.

The original Board of Trustees and members of the corporation of the Woods Hole Oceanographic Institution, chosen to serve until the first annual meeting, consisted of thirteen persons, as follows: Thomas Barbour, of Harvard University; Henry B. Bigelow, of Harvard University; William Bowie, of the United States Coast and Geodetic Survey; Newcomb Carlton, of New York City; E. G. Conklin, of Princeton University; B. M. Duggar, of the University of Wisconsin; Frank R. Lillie, of the University of Chicago; John C. Merriam, of the Carnegie Institution of Washington; Seward Prosser, Lawrason Riggs, Jr., and Elihu Root, Jr., of New York City; Harlow Shapley, of Harvard University; and T. Wayland Vaughan, of the Scripps Institution of Oceanography at La Jolla, California. Dr. Lillie was elected president of the corporation and Dr. Bigelow clerk of the corporation and director of the Laboratory. They served in their respective offices until 1939, when Dr. Bigelow succeeded to the office of president and C. O'D. Iselin was elected clerk and director.

The first meeting of the Board was held for purposes of organization in New York on January 15, 1930, after formal incorporation in the commonwealth of Massachusetts on January 6, 1930 (IX, A, 1, and IX, A, 2). Dr. Mason appeared at this meeting, by invitation, and stated the relation of the Rockefeller Foundation to the project: the Executive Committee would be glad to consider a formal request from the Woods Hole Oceanographic Institution for funds sufficient to establish the institution on a permanent working basis, with the

understanding that the necessary land would be taken care of by others. Mr. Lawrason Riggs and Dr. Henry B. Bigelow, treasurer and director, respectively, of the Woods Hole Oceanographic Institution, were then instructed to make the request on behalf of the new institution in accordance with the previous understandings.

The application was accordingly made to the Rockefeller Foundation; and on February 13, 1930, the following action was taken by the Executive Committee of the Foundation:

RESOLVED: that the sum of two million dollars ($2,000,000), or so much thereof as may be necessary, be, and it is hereby, appropriated to the Woods Hole Oceanographic Institution of which $1,000,000 shall be for BUILDING and other construction, boats, equipment and endowment of upkeep of building payable as needed; and $1,000,000 shall be for ENDOWMENT of the station payable upon completion of the building.

RESOLVED: that the sum of Five hundred thousand dollars ($500,000) or so much thereof as may be necessary, be, and it is hereby, appropriated to the Woods Hole Oceanographic Institution for CURRENT EXPENSES over a period of ten years beginning approximately March 1, 1930, payments in any one year not to exceed $50,000.

In 1935 the annual grant of $50,000 a year for a ten-year period was replaced by the addition of $1,000,000 to the endowment from the Rockefeller Foundation.

The best side for the location of buildings and wharves of the Institution was part of the property of the Marine Biological Laboratory located on the Great Harbor at Woods Hole. Although the trustees of the Marine Biological Laboratory had voted to transfer this site to the new institution, it was subsequently discovered that they did not have the legal right to do so without adequate remuneration. Provisional arrangements were made, and transfer of title was effected to permit building operations; in October, 1930, the Carnegie Corporation, in response to an appeal, made a gift of $27,000 to the Oceanographic Institution to cover the appraised cost of the site.

The location of the Institution with reference to the other scientific laboratories of Woods Hole is shown on the plan of land and buildings (p. 64). The airplane view (p. 69) shows the building and the beautiful ketch "Atlantis," mainstay of the Institution, at her berth.

The building, 135 × 50 feet, with four stories and basement, will accommodate about one hundred workers. It is of substantial fireproof construction; running salt water is provided everywhere from a

tank in the attic, supplied from the pumping station; it has all the usual, and many special, laboratory facilities. There are a few general laboratories, not of large size; and most of the workrooms are individual. It is very amply supplied with apparatus.

The "Atlantis," of steel construction, 142 feet long and with a beam of 29 feet, is probably the best oceanographic vessel in existence. Her design was prepared with the advice of many scientific institutions and embodies the best practices available. She was built in Copenhagen, Denmark, from plans prepared by marine architects in Boston. She is powered by a Diesel engine of 250–300 horse-power, giving a speed of about 9 knots per hour, which can be regulated to lower speeds by a feathering propeller. She has a considerable range under power, but most of her cruising is done under sail. Her equipment includes: deep-sea wire sounding apparatus, sonic depth-sounder, radio communications, complete set of hydrographic apparatus, nets, and meteorological and all important minor apparatus. She has both a biological and a chemical laboratory for work at sea and accommodations for a crew of about seventeen and for six scientific workers. Her work is supplemented by the 40-foot "Asterias," for work near shore, and by the 70-foot "Anton Dohrn," presented by the Carnegie Institution in 1940 after cessation of the work at its marine laboratory on the Dry Tortugas.

II. The Work of the Woods Hole Oceanographic Institution

Oceanographic investigation is as much dependent on an ocean-going, specially equipped vessel as astronomy is on an observatory and telescopic equipment. Such a vessel is the "Atlantis." Observations from this vessel may be routine or special, and in any given cruise a great variety of data may be secured, bearing on many different problems. Routine observations, such as are made on practically every cruise, include: determinations of depths by the sonic sounding apparatus, securing of bottom samples; physical determinations, such as temperatures and salinity, light penetration, and direction and rates of surface and deep currents; chemical determinations, such as oxygen and nitrogen and phosphate concentrations, alkalinity measurements, etc.; biological collections by plankton nets of various kinds, by trawls, etc.; and a great variety of meteorological observations. More special functions on cruises include: surveys of special geographical locations, such as the Gulf of Maine, the Gulf of Mexico, or

the Caribbean Sea; special studies of the Gulf Stream; special biological surveys; the testing of bathythermographs; submarine seismic determinations; etc. In the first ten years, 1931–40, the "Atlantis" made 109 cruises, was at sea about two-thirds of the time, and covered about 150,000 nautical miles.

The purposes of the Woods Hole Oceanographic Institution are stated in the Act of Incorporation (IX, A, 1):

> To prosecute the study of oceanography in all its branches; to maintain a laboratory or laboratories, together with boats and equipment and a school for instruction in oceanography and allied subjects; to accept and hold money, and property of any kind whatsoever, and wherever situated, and whether received through bequest, devise, gift or otherwise; and to apply from time to time and at any time to the purposes of the corporation, or to any of them, all or any part of the income and/or principal of any funds and/or property held by the corporation; . . . .

The recommendations of the Committee on Oceanography quoted previously (pp. 180–82) elaborate and explain the above statement of purposes, which may be summarized under the following heads:

1. Research in all branches of oceanography
2. Instruction in oceanography and allied subjects
3. To provide facilities for visiting investigators
4. To co-ordinate the activities of governmental and private organizations in oceanography, especially on the Atlantic Coast

1. Research

Oceanography is an immense subject, whether considered with reference to its geographic extent of about three-quarters of the earth's surface, to the variety of the scientific disciplines involved, or to the enormous economic interests affected by knowledge about the oceans in times of peace or of war. Considered first as a field of knowledge, it is customary to distinguish geological, meteorological, physical, chemical, and biological aspects, though these interconnect and balance at any given time. The first four belong together as physical oceanography, constituting the environment of the amazing development, both quantitative and qualitative, of life in the ocean.

Henry B. Bigelow has dealt with these subjects and their interrelations in a simple and comprehensive way in his book on oceanography (II, 1). It is no part of our purpose, nor is there space, to repeat what he has said so well there. Owing to the interconnections of the various disciplines, it is impossible to omit any of them from the program of such a central co-ordinating institution as the Woods Hole Oceanographic Institution aims to be. This institution differs funda-

mentally in its mode of operation from the Marine Biological Laboratory, inasmuch as its primary emphasis is based upon specific projects directed by a permanent scientific staff; and it serves only secondarily in support of problems of visiting investigators.

Submarine geology has been an active project under the general direction of Henry C. Stetson since the founding of the Institution in 1930, starting from the study of the distribution of marine sediments from the shore line to the continental slope. This led to a study of submarine canyons, as well as of sediments, from Maine to Virginia. Core samples have been used from the start to determine rates of deposition, indicated by the occurrence of shells of Foraminifera at various core depths and in other ways; methods were devised for obtaining rock specimens from the walls of submarine canyons which have been identified in eight cases with coastal-plain geological formations.

Projects in marine meteorology have also been pursued from the foundation of the Institution under the direction of Professor C. G. Rossby, of the Massachusetts Institute of Technology (now of the University of Chicago). The studies have been principally from the point of view of physical oceanography, such as the tangential stress of the wind along the surface of the ocean, the relations between atmospheric and oceanographic turbulence, evaporation measurements, vertical distribution of temperatures and vapor-pressure gradients above the surface of the ocean, wind-produced convergence of surface water, and general relations of atmospheric factors to dynamical oceanography. Since 1935 Dr. Raymond B. Montgomery has been associated with this work.

Studies in physical oceanography have been under the general direction of C. O'D. Iselin, who also served as master of the "Atlantis" during the first year and in 1940 became director of the Institution. However, the field is broad, and many members of the staff and visiting investigators have been concerned with various phases. Special attention has been directed to the study of the currents and dynamic oceanography of the Labrador Sea and the Grand Banks of Newfoundland, in co-operation with the United States Coast Guard and the International Ice Patrol since 1933; and, in co-operation with the Bermuda Biological Station and the Royal Society of London, to the study of fluctuations of the warm currents, specifically the Gulf Stream, since 1936. The circulation of the waters of the Gulf of Maine has been examined in considerable detail. As a by-product of these

and other special studies, knowledge of the distribution of temperature and salinity in the whole western North Atlantic has been greatly increased, and it is now clear that the major features of this distribution can be explained on the basis of the circulation theorem. Thus, of recent years the smaller-scale phenomena, such as eddies and convectional circulations, have received increased attention. Light penetration in the oceanic waters has also been systematically investigated in connection with distribution of small marine organisms, both plant and animal. Many improvements in design of instruments have been made, and new instruments and methods devised.

Chemistry in the service of oceanography has two main functions: (1) the study of transformations of solutes with reference to life in the oceans, to the maintenance of a constant chemical equilibrium in the body of the ocean itself, and to geological transformations of deposition or removal; and (2) to serve as a routine discipline in various inorganic or organic analyses. Such analyses furnish an almost limitless variety of problems, especially where chemistry and biology meet in the seasonal and depth variations of oxygen, carbon dioxide, nitrates, nitrites, organic nitrogen in particulate matter or in solution, phosphates, etc., which have been under systematic investigation by Norris W. Rakestraw, H. R. Seiwell, Th. von Brand, and others. A. Krogh and Ancel B. Keys have also contributed to study of these problems. A number of special studies of the content of iron, copper, arsenic, boron, and aluminum in sea water have also been made. On the whole, the chemical program runs parallel to biological studies. The routine work of the chemists in connection with other projects of the Institution is large.

By far the most complex of oceanographic problems are those relating to life in the sea. In sheer quantitative manifestations the life supported by the oceans far outweighs all other life. Its quantity is so great with reference to the body of the water that most chemical variations of sea water are directly due to the living things in it: their utilization of the gaseous and mineral solutes, on the one hand; and their metabolism and the return of their dead bodies to the water and disintegration in it, on the other. In these senses marine biology is a fundamental part of general oceanography. It is convenient, as Bigelow states (II, 1, p. 126), to divide the study of marine biology into three parts: (1) marine botany and zoölogy, (2) marine physiology, and (3) marine bacteriology. The first of these, in spite of its almost uncanny fascination, has not been a major preoccupation of the

Institution, but some interesting collections have been made and a few studies published. Its bearing on general oceanography is not very direct. Emphasis has been laid on physiology and bacteriology as having direct bearing on general oceanography. Professor Alfred C. Redfield, of Harvard University, has functioned as senior biologist since the foundation of the Institution.

Special attention has been accorded marine bacteriology since the first cruise in 1931, under the general direction of Dr. Selman A. Waksman. It was a very undeveloped subject in 1931; adequate techniques of culture did not exist and had to be developed. After that it was possible to determine the numbers of bacteria in the sea water and in the bottom muds and sediments in various localities and depths, and from this to proceed, as a general aim, with the study of their role in the decomposition of organic matter in the sea. Special attention has been given to their predominant role in the nitrogen cycle of the sea, on which first steps in synthesis of living matter by the phytoplankton depends. Nitrogen-fixing, nitrifying, and denitrifying bacteria may be distinguished. All dead organic matter in the sea, whether in particulate form or in solution, appears to be available for bacterial growth.

Studies of the phytoplankton, especially the diatoms, and of the zoöplankton, as the next step in the cycle of life in the ocean, have also continued uninterruptedly. Determinations of the distribution and numbers of these organisms in relation to diurnal and seasonal cycles and to depth are supplemented by numerous physiological studies of higher stages of the marine life-cycle.

2. Instruction and Facilities for Visiting Investigators

Formal instruction is not given at the Woods Hole Oceanographic Institution. On the other hand, provision is made annually for the training of beginning investigators by the appointments of fellows from specially qualified applicants to work under the direction of members of the staff for varying periods of time—a kind of apprenticeship system; there are generally about twelve of these. About an equal number of assistants work for members of the staff or visiting investigators. From such young workers, who receive part of their training in a very practical way at the Woods Hole Oceanographic Institution, the growing body of oceanographers in the United States is constantly being recruited. The Institution is fulfilling the intention of its founders to provide a place, supplementing the facilities of edu-

cational institutions, in which advanced students may gain technical experience in various phases of oceanography. The theoretical and systematic training remains a function of the universities from which the students come.

The Institution also provides facilities for visiting investigators from at home and abroad—usually about fifteen to twenty in number. In 1939 over one hundred workers in all were accommodated; these represented twenty-nine institutions, of which seventeen were American colleges and universities, five were foreign institutions in Canada, Bermuda, Cuba, Scotland, and Sweden, and the remainder were made up from the United States Coast Guard and special laboratories.

The Institution issues annual reports containing lists of trustees, members, and staff and the reports of the treasurer and director and of progress of investigations under way. An annual announcement is also issued. The main outlet for publications is "Papers in Physical Oceanography and Meteorology," published jointly with the Massachusetts Institute of Technology in continuation of their "Papers in Meteorology." Seven volumes of the joint periodical, of four numbers each, and two numbers of an eighth volume have appeared. Other results of investigations are published separately in various scientific journals, and reprints are assembled in bound volumes. The original contributions to oceanographic research, numbered serially, were three hundred and six at the end of 1941; seventy current journals are received in exchange for these publications.

3. Co-ordination of Activities of Governmental and Private Organizations

Part of the original plan was that the Institution should serve as a center of co-ordination, especially on the Atlantic Coast, of oceanographic research which was being carried on from a number of specialized centers, governmental and otherwise, without much centralization. The government agencies—the Navy, Bureau of Fisheries, Coast Guard, Coast and Geodetic Survey, and lighthouse services—are naturally by far the most powerful agencies in certain phases of oceanographic research. Their good will was displayed from the start, perhaps most conspicuously in the composition of the Board of Trustees of the Institution, of which the Secretary of the Navy, the chief of the Hydrographic Office of the Navy, and the director of the Coast and Geodetic Survey were original members. To these government representatives the commandant of the United States Coast Guard was subsequently added (VII, A, 3). With the exception of the

Secretary of the Navy, the government trusteeships have become ex officio appointments.

The Institution has served the government in many special ways and latterly to an increasing extent. On the other hand, the Institution has been indebted to government services for much help in special problems. The Bureau of Fisheries was aided by the "Atlantis" in several years in their work on mackerel and on the eggs and young of halibut in the Gulf of Maine and off the Georges Banks. Land quarters have been furnished in the Institution for the International Ice Patrol, conducted by Coast Guard vessels for many years, and oceanographic data exchanged. Members of the International Passamaquoddy Bay Commission used facilities of the Institution during the brief period of its operations. The Hydrographic Office of the Navy has enjoyed the hospitality of the "Atlantis," receives data on the stations of the "Atlantis" during cruises, and has been aided in hydrographic investigations off Cuba and elsewhere. The United States Navy has received aid in various investigations, among which the study of the fouling of submerged bodies, with special reference to ships' bottoms, may be mentioned.

Co-operative arrangements with nongovernmental institutions are also in constant operation. The Marine Biological Laboratory at Woods Hole serves as a depository for the library of the Institution, which enjoys all the benefits of the large collections of the Marine Biological Laboratory library, an arrangement of great mutual benefit. Other reciprocal exchanges of services are regularly made. As noted before, the Committee on Oceanography was concerned with the endowment of the Bermuda Biological Station at the same time that the Woods Hole Oceanographic Institution was established. Until the breaking-out of the second World War in 1939, this station served as a regular port-of-call of the "Atlantis" on her southern cruises and participated in the work from Bermuda in various ways. This relationship became closer in 1936, when a grant of money was made by the Empire Development Board of London to the Bermuda station; this was administered by a committee of the Royal Society of London and was used largely in a joint investigation of the Gulf Stream, for which a 78-foot auxiliary ketch was furnished by the fund to cooperate with the "Atlantis." The study, now interrupted by the war, was intended to determine, among other things, any correlations that may exist between variations of the current and climatic conditions in northern Europe.

Since 1933 the Institution has co-operated with the Bingham Oceanographic Foundation of Yale University, under the direction of Dr. Albert E. Parr, in oceanographic investigations of the Caribbean Sea and the Gulf of Mexico. The Bingham Foundation has contributed to the expenses of these expeditions of the "Atlantis" and has furnished scientific members of the staff. Since 1936 the "Atlantis" has co-operated with the Geophysical Laboratory of the Carnegie Institution of Washington in the study of the deposition of deep marine sediments by the method of securing cores by the coring tube designed by Dr. C. S. Piggot, of the Carnegie Institution. (The tube is driven, by a timed explosion, as much as 10 feet into the sediments; and, after the closing of the tube, the core is returned to the vessel for preservation and study.) With Lehigh University, under the direction of Dr. Maurice Ewing, methods for securing seismic measurements in the ocean floor have been developed.

Among the universities, the connections are closest with Harvard, which has furnished from its department of oceanography the first two directors of the Institution and many members of the staff. The Massachusetts Institute of Technology has provided the head for marine meteorology in the person of Professor C. G. Rossby; Brown University has furnished the research director of physical chemistry, Dr. Norris W. Rakestraw; the New Jersey Agricultural Station has furnished the chief microbiologist and bacteriologist in the person of Professor Selman A. Waksman. Other institutions are also represented on the staff (IX, A, 4). All the major appointments are on part time—an arrangement which not only secures constant co-operation of the universities in question but also counteracts any narrowing effects which exclusive devotion to the specialized problems of the Woods Hole Oceanographic Institution might involve.

APPENDIX TO CHAPTER II

II, A, 1

Announcement of proposed school for natural history on Nantucket Island, from the "Report of the Trustees of the Anderson School of Natural History, 1873."

MUSEUM OF COMPARATIVE ZOÖLOGY, CAMBRIDGE, MASS.

DECEMBER 14, 1872.

Programme of a Course of Instruction in Natural History, to be delivered by the Sea-side, in Nantucket, during the Summer Months, chiefly designed for Teachers who propose to introduce the Study into their Schools, and for Students preparing to become Teachers.

Zoölogy in general, and Embryology of the Vertebrates, by L. AGASSIZ, Director of the Museum.

The Extinct Animals of Past Ages, compared with those now living, and the Methods of identifying them, by N. S. SHALER, Professor of Palaeontology in the Lawrence Scientific School.

Comparative Anatomy and Physiology of the Vertebrates, by Dr. B. G. WILDER, Professor of Anatomy and Physiology in Cornell University, Ithaca, N.Y.

The Animals and Plants living in Deep Waters, and the peculiar Conditions of their Existence, by L. F. de POURTALES, Assistant in the United States Coast Survey.

Embryology of the Radiates, by A. AGASSIZ, Assistant in the Museum of Comparative Zoölogy.

Natural History and Embryology of the Mollusks, by. . . . .

How to make Biological Collections to illustrate the History of Insects Injurious to Vegetation, by H. A. HAGEN, Professor of Entomology in Harvard University.

Natural History and Embryology of the Articulates, by Dr. A. S. PACKARD, Professor of Entomology in the Mass. Agricultural College.

Natural History of the Fishes and Reptiles, by F. W. PUTNAM, General Secretary of the Am. Assn. for the Advancement of Science.

Natural History of Birds and Mammals, by J. A. ALLEN, Assistant in the Museum of Comparative Zoölogy.

On Breeding, and Nests and Eggs of Birds, by. . . . .

Practical Exercises in the Use of the Microscope, by. . . . .

Instruction in Drawing and Painting of Animals, by PAULUS ROETTER, Artist in the Museum of Comparative Zoölogy.

On Fisheries and their Management, by Professor SPENCER F. BAIRD, Asst. Sec. of the Smithsonian Institution.

On Fish Breeding, by THEODORE LYMAN, Assistant in the Museum of Comparative Zoölogy.

The Faunae of the North Atlantic, compared with one another, and with those of other Parts of the World, by. . . . .

The Plants of the Sea, by. . . . .
The Physics of the Sea, by. . . . .
Physical Hydrography, by Professor W. MITCHELL, Asst. in the United States Coast Survey.
Chemistry of Feeding and Breathing, by Professor W. BIGGS, Rumford Professor of Physics in Harvard University.
Chemistry of the Sea and Air, by Professor JAMES CRAFTS, Professor of Chemistry in the Technological Institution in Boston.

The terms of admission, and the day of opening the course, will be advertised as soon as all the necessary arrangements in Nantucket can be made, including information concerning board, etc. A number of aquariums and the necessary apparatus to dredge in deep water will be provided. The Superintendent of the United States Coast Survey and the United States Commissioner of Fisheries have promised their co-operation to the extent of their ability, without interfering with the regular service of their departments. Professors SHALER, WILDER, PACKARD, and PUTNAM, and perhaps others, may spend the whole, or nearly the whole, season in Nantucket, with a view to superintend the laboratory work, while the other gentlemen will stay there only part of the time, or as long as required by the share they are able to take in the course of instruction.

In behalf of the Faculty of the Museum of Comparative Zoölogy in Cambridge, Mass.,

L. AGASSIZ.

II, A, 2

Letter transmitted to Louis Agassiz, March, 1873, by Mr. W. Girod, agent for Mr. John Anderson, of New York, from the "Report of the Trustees of the Anderson School of Natural History, 1873."

Mr. Anderson has read with much interest the appeal recently addressed by you to the Legislature of Massachusetts, and, although not possessing himself any intimate acquaintance with the department of science to which your distinguished talents have been so long and so successfully devoted, he sympathizes warmly in the project originated by you for making that department of science a branch of education. Mr. Anderson is owner of an island charmingly situated in Buzzard's Bay, in your State. It is known as Penikese, and is the most easterly of the three western islands of the Elizabeth group. It contains somewhere in the neighborhood of one hundred acres, of great fertility, and presents in every way a most attractive location for a summer residence . . . . . It has occurred to Mr. Anderson, on reading your address, that this island possesses advantages which would adapt it peculiarly to the objects contemplated by you. It has a beautiful little bay, near which the dwelling-house and buildings have been erected. . . . . There are several springs of fine fresh water, and present accommodation, in the shape of buildings, for the party who may be expected to associate themselves with you during the first season; and this accommodation could of course be indefinitely increased. Mr. Anderson is willing, and has authorized me in his name to offer to your institution, as a free gift, the entire fee-simple of this island, its buildings and improvements, to be perpetually used as a location for your proposed naturalists' school, if upon inquiry or a personal examination, you shall find

it suitable for that purpose, or if your previous arrangements should not have precluded you from accepting it. It would be a source of extreme gratification to Mr. Anderson to be so far instrumental in providing a habitation, if not a name, for an institution destined, it is to be hoped, in the future to disseminate throughout this great country that love of scientific investigation, of the advantages of which you display in your own person so brilliant an example.

II, A, 3

Louis Agassiz's reply to the offer of Mr. Anderson, from the "Report of the Trustees of the Anderson School of Natural History, 1873."

CAMBRIDGE, March 15, 1873.

John Anderson, Esq.

MY DEAR SIR,—It seems to me impossible to do otherwise than accept the great gift you offer. It changes at once an experiment without fixed location or stable foundation into a permanent school for the study of nature, such as the world has not seen before. If I have a doubt in my mind, it is because there may be practical difficulties in the way which I am personally unable to meet. I have long cherished the thought of a summer school like the one proposed, and I have at various times in my life tried it with small classes, and for a few days or weeks at a time. The idea of establishing one at Nantucket, on a larger scale, was suggested by a young friend, Professor N. S. Shaler, who has a special taste and no little experience in this kind of teaching. Failure of health has obliged him to go abroad, and the care of organizing the whole scheme falls naturally into my hands. I had thought that the arranging a plan of summer instructions in natural history, founding courses of lectures to be given by myself and others, and being from time to time on the spot to see that all went well, would be quite within my strength, and that the minor questions, such as providing for the board and lodging of such persons as might come, would be easily arranged in a town like Nantucket, and might, indeed, be left in a great degree to themselves.

At Penikese Island, however, we must live like a large family. A farmer and caterer would be a necessity. Accommodation must be provided within the precincts of the island itself for those who come; and however simple the mode of life adopted, a well-ordered domestic economy will be required. The pupils who would resort to such an institution have usually small means, and it would therefore be an essential condition of success that everything should be organized on the cheapest basis consistent with comfort. I have neither health, strength, nor time for more than the general direction of the scientific work, and I am a little at a loss to know how the material part should be managed. However, even should we be obliged to limit the undertaking at first to such accommodations as the island now affords, I think it would be far better than to begin it at Nantucket, or at any other place where we can have no certainty of carrying it on, summer after summer. Your noble endowment offers permanence and progress. In the interest of science, I gratefully accept it, and will do all that I can to found a school for naturalists, with which your name will always be associated, and which will introduce into our system of education the element it so much needs,—a familiarity with nature.

With great regard, yours, very truly,

LS. AGASSIZ

II, A, 4

Second letter from Mr. Anderson to Louis Agassiz, from the "Report of the Trustees of the Anderson School of Natural History, 1873."

New York, March 19, 1873

Professor Louis Agassiz
Director of Museum,
Cambridge, Mass.

My Dear Sir,—I have received your letter of the 15th instant, announcing your acceptance of Penikese Island as a permanent location for the Summer School of Natural History which it is your desire to found in connection with the Museum of Comparative Zoölogy at Cambridge; and I can say with the utmost sincerity, that no act of my life has afforded me so much gratification as to have given what you seem to consider a substantial foundation to an institution fraught with so much promise of intellectual improvement and general usefulness as that in contemplation.

Business occupations commenced at a very early period of my life, and continued unceasingly and laboriously up to a date not yet remote, have prevented me in a great measure from acquiring in my own person many of the benefits which spring from an intimate acquaintance with that department of science of which you have been so conspicuous an ornament, and to which you have been for so long a time devoted, in the service of this country; but no man appreciates more highly than I do the advantages to be derived from an extension of general knowledge throughout this country, and especially a knowledge of that science which enables mankind to utilize nature in almost every department of industrial economy. Most earnestly do I hope that this gift of Penikese may become, as you seem to believe it will, the basis of a permanent foundation, which, under your able direction, may be destined in future ages not only to afford the required instruction to the youth of our own country, but may be the means of attracting to our shores numerous candidates from the Old World, who may find here, in the School about to be founded by you, those means of fitting themselves for the teaching of natural history from Nature herself, which, by a strange oversight, appear to have been overlooked in the schemes (generally so well conceived and executed) of education here.

You refer in your letter to practical difficulties that present themselves in the way of the complete realization of your views, arising out of the pecuniary requirements which such an institution would necessarily involve. I have not overlooked this feature in the scheme, and I am prepared to tender my assistance in overcoming this difficulty. I will place at your disposal a sum of fifty thousand dollars, to be invested as the nucleus of a permanent endowment fund, so that the interest may be ever after available for the support and maintenance of the institution. This sum I will place in your hands at the same time with delivery of the deed for the island, which deed shall be prepared and executed so soon as the settlement shall have been definitely arranged.

I learn from Mr. Girod that you have expressed a wish to mark your appreciation of my gift of Penikese for the purpose of the institution, by naming the latter after me. I feel necessarily deeply flattered by this offer, and can only say in reference to it that I leave that part of the question entirely in your hands, simply suggesting whether an institution, the initiation of which has been wholly the result of your own industry, and which must depend for success mainly on your own labors, should not more aptly

receive its designation from a name which has become almost a household word wherever science is known and appreciated,—that of Louis Agassiz. I shall be happy to execute a deed for the island in such a form as you may, on consideration, deem best calculated to give effect to your views for the future government of the institution; and I can only express an earnest hope that your efforts may be crowned with all the success they deserve, and that you may have the satisfaction of bequeathing to posterity the benefits of an institution second to none of the kind in the world, and owing its usefulness wholly to your disinterested services in the interests of science and of your adopted country.

With great regard, yours, very truly,
JOHN ANDERSON

II, A, 5

Reply of Louis Agassiz to Mr. Anderson's letter of March 19, 1873, from the "Report of the Trustees of the Anderson School of Natural History, 1873."

MUSEUM OF COMPARATIVE ZOÖLOGY
CAMBRIDGE, MASS.
March 22, 1873

John Anderson, Esq.

MY DEAR SIR,—A hearing before the Committee on Education in the Massachusetts Legislature made it impossible for me to write by return mail yesterday in acknowledgment of your additional endowment of $50,000 to the Summer School for Natural History. I am overwhelmed by your generosity. Such a gift, following so close upon the donation of an island admirably adapted by its position for the purposes of a practical school for natural history, opens visions before me such as I had never dared to indulge in connection with this plan. You do not know what it is suddenly and unexpectedly to find a friend at your side full of sympathy, and offering substantial support to a scheme which you have been trying to carry out under difficulties and with very scanty means. I feel very grateful to you for making the road so easy, and I believe you will have the permanent gratitude of scientific men here and elsewhere, for I have the utmost confidence that this Summer School will give valuable opportunities for original investigations as well as for instruction. As to its name, I hope you will allow the School to be named for you. I thank you for the thought of making me the godfather; but my name it cannot bear with any propriety. I am but one of many scientific men who have already offered their services to it for the coming summer, some of whom I have no doubt will continue to work for it in future, and all of whom will be equally indebted to you for the advantages it offers. To name it after you is therefore the simple and appropriate way of settling the question, and I hope you will consider it as a natural expression of the gratitude which all connected with the school, either as teachers or pupils, must feel toward you.

As to the mode of drawing up the settlements, I think it advisable not to connect the endowment with any State or university organization, but to allow the School the greatest independence and freedom of development. I should, however, wish it to be associated with the Museum of Comparative Zoölogy in such a way as to share at once and forever in any advantages to be derived from an institution so kindred in its objects and aims. These two establishments for the study of natural history will, at

least for the present, and probably always, be under the same general direction, and can work together to the greatest advantage of both. Indeed, I foresee that the most direct co-operation may exist between them, and I should wish that the terms of any settlement about the landed property and the income should not limit the working of the School to the summer months only, but include the idea of continuing its operations in connection with the Museum in Cambridge during the whole year. We have rich and extensive collections which may be made of infinite service to the School we are about to establish. Indeed, when I first thought of it, it was as a summer session of our Museum work. I am somewhat in doubt as to the nature of the board or faculty to which the care of your generous endowment should be intrusted, and about the formation of which Mr. Girod has consulted me. Any action on your part which would accelerate proceedings would be gratifying to me, even if it should require readjustment after more mature consideration, since it is important to proceed at once to the preparation of laboratories, apparatus, etc. I am very anxious to relinquish all arrangements made with reference to Nantucket, and to open the School at once where it is to have its permanent home. Indeed, I am now employing every moment I can spare in making sketches for laboratories on the most simple and inexpensive plan possible, and for other necessary arrangements. I shall hope to be often on the ground myself, and to have you as a neighbor and adviser. It will, however, not be possible for me to pass the whole summer at Penikese Island, but I shall be there as frequently and for as long intervals as is consistent with my other work and with my family arrangements. With great respect,

Yours respectfully,
Ls. Agassiz.

II, A, 6

From the "Report of the Trustees of the Anderson School of Natural History, 1873."

CATALOGUE OF THE ANDERSON SCHOOL FOR 1873

Students in Attendance

Coffin, Helen B.,	Castine,	Me.	Teacher in Eastern State Normal School.
Fernal, Ch. L.,	Orono,	"	Professor, Maine State College.
Hooper, F. W.,	Walpole,	N.H.	Student at Harvard College.
Adams, Ch. F.,	Fitchburg,	Mass.	Teacher in High School.
Bowen, Susan,	South Hadley,	"	Teacher in Mount Holyoke Seminary.
Cole, Caroline J.,	Salem,	"	Teacher in State Normal School.
Davis, Mary E.,	E. Somerville,	"	Teacher in High School.
Faxon, Walter,	Cambridge,	"	Instructor in Museum of Comparative Zoölogy.
Fewkes, J. Walter,	Newton,	"	Student at Harvard College.
Garman, S. W.,	Cambridge,	"	Museum of Comparative Zoölogy.
Hale, Silas W.,	Milford,	"	Principal of High School.
Hanson, M. Isabel,	Newtonville,	"	Newton Training School.
Ireland, Catherine,	Boston,	"	Teacher of Private School.

Ingersoll, Ernest,	Cambridge,	Mass.	Museum of Comparative Zoölogy.
Miller, A. B.,	Pittsfield,	"	Teacher in Maplewood Institute.
Minot, Chas. S.,	Jamaica Plain,	"	Zoölogical Student.
Shattuck, Lydia,	South Hadley,	"	Teacher in Mount Holyoke Seminary.
Smith, Sarah R.,	Boston,	"	Teacher in Chauncy Hall School.
Scott, J. B.,	Westfield,	"	Teacher in Normal School.
White, Mary B.,	New Bedford,	"	Teacher in Training School.
Whitman, C. O.,	Boston,	"	Teacher in English High School.
Whitney, Solon,	Watertown,	"	Teacher in Cambridge High School.
Cook, S. R.,	Brooklyn,	N.Y.	Teacher in Packer College Institute.
Bearnan, Mary E.,	Binghamton,	"	Teacher in High School.
Hall, Chas. E.,	Albany,	"	State Museum of Natural History.
Holman, Lavinia,	New York City,	"	Teacher in Normal College.
Johnson, Amy,	Poughkeepsie,	"	Teacher in Brooks Seminary.
Stowell, T. B.,	Cortland,	"	Professor in State Normal School.
Apgar, A. C.,	Trenton,	N.J.	Teacher in State Normal School.
Burns, Mrs. V.,	Pittsburgh,	Pa.	Teacher in Public School.
Tingley, J.,	Meadville,	"	Teacher in Allegheny College.
Moses, Thos. F.,	Urbana,	Ohio	Teacher of Natural Science.
Claypole,	Yellow Springs,	"	Professor at Antioch College.
Brooks, W. K.,	Cleveland,	"	Teacher.
Gastman, E. A.	Decatur,	Ill.	Superintendent of City Schools.
Whipple, Elliot,	Bunker Hill,	"	Principal of Academy.
Reid, Zella,	Salem,	Ind.	Antioch College.
Crosby, Eugene C.,	Kansas City,	Mo.	Teacher.
Johonnot, Marion,	Warrensburg,	"	Teacher in State Normal School.
Johonnot, James,	"	"	" " " " "
Straight, H. H.,	"	"	" " " " "
Straight, Emma,	"	"	" " " " "
Crosby, W. O.,	Georgetown,	Col.	Student in Boston School of Technology.
Jordan, David S.,	Appleton,	Wis.	Instructor in Botany.

II, A, 7

THE PRAYER OF AGASSIZ[1]

JOHN G. WHITTIER

On the isle of Penikese,
Ringed about by sapphire seas,
Fanned by breezes salt and cool,
Stood the Master with his school.
Over sails that not in vain,
Wooed the west wind's steady strain,
Line of coast that low and far
Stretched its undulating bar,

[1] Published in 1874.

Wings aslant along the rim
Of the waves they stooped to skim,
Rock and isle and glistening bay,
Fell the beautiful white day.

Said the Master to the youth:
"We have come in search of truth,
Trying with uncertain key
Door by door of mystery;
We are reaching, through His laws,
To the garment-hem of Cause,
Him, the endless, unbegun,
The Unnamable, the One,
Light of all our light the Source,
Life of life, and Force of force.
As with fingers of the blind
We are groping here to find
What the hieroglyphics mean
Of the Unseen in the seen,
What the Thought which underlies
Nature's masking and disguise,
What it is that hides beneath
Blight and bloom and birth and death,
By past efforts unavailing,
Doubt and error, loss and failing,
Of our weakness made aware,
On the threshold of our task
Let us light and guidance ask,
Let us pause in silent prayer!"

Then the Master in his place
Bowed his head a little space,
And the leaves by soft airs stirred,
Laps of wave and cry of bird
Left the solemn hush unbroken
Of that wordless prayer unspoken,
While its wish, on earth unsaid,
Rose to heaven interpreted.
As, in life's best hours, we hear
By the spirit's finer ear
His low voice within us, thus
The All-Father heareth us;
And his holy ear we pain
With our noisy words and vain.
Not for Him our violence
Storming at the gates of sense,
His the primal language, his
The eternal silences!

Even the careless heart was moved,
And the doubting gave assent,
With a gesture reverent,
To the Master well-beloved,
As the mists are glorified
By the light they cannot hide,
All who gazed upon him saw,
Through its veil of tender awe,
How his face was still uplit
By the old sweet look of it,
Hopeful, trustful, full of cheer,
And the love that casts out fear.
Who the secret may declare
Of that brief, unuttered prayer?
Did the shade before him come
Of th' inevitable doom,
Of the end of earth so near,
And Eternity's new year?

In the lap of sheltering seas
Rests the isle of Penikese;
But the lord of the domain
Comes not to his own again;
Where the eyes that follow fail,
On a vaster sea his sail
Drifts beyond our beck and hail;
Other eyes from rock and shell
Read the world's old riddles well;
But when breezes light and bland
Blow from Summer's blossomed land,
When the air is glad with wings
And the blithe song-sparrow sings,
Many an eye with his still face
Shall the living ones displace,
Many an ear the word shall seek
He alone could fitly speak.
And one name for evermore
Shall be uttered o'er and o'er
By the waves that kiss the shore,
By the curlew's whistle sent
Down the cool, sea-scented air;
In all voices known to her
Nature own her worshiper,
Half in triumph, half lament.
Thither Love shall tearful turn,
Friendship pause uncovered there,
And the wisest reverence learn
From the Master's silent prayer.

II, A, 8

Extracts from the first announcement of the Annisquam Laboratory, 1881, from the report of the curator of the Boston Society of Natural History published in the Society's "Proceedings," 22: 9–11, 1882–83.

NEW SEA-SIDE LABORATORY

The liberality and co-operation of the Woman's Education Association enable the Boston Society of Natural History to announce that a Sea-side Laboratory, under the direction of the Curator and capable of accommodating a limited number of students, will be open at Annisquam, Mass., from June 5th to Sept. 15th.

Annisquam is situated on an inlet of Ipswich Bay, on the north side of Cape Ann, and is about three and a half miles by coach from the Eastern Railroad Company's station in Gloucester.

The purpose of this Laboratory is to afford opportunities for the study and observation of the development, anatomy and habits of common types of marine animals under suitable direction and advice. There will therefore be no attempt, during the coming summer, to give any stated course of instruction or lectures.

It is believed that such a Laboratory will meet the wants of a number of students, teachers and others *who have already made a beginning in the study of Natural History.* Those who have had some limited experience in a laboratory, or who have attended the practical lessons given by the Teachers' School of Science of the Boston Society of Natural History, are sufficiently qualified to make use of this opportunity.

The work in the Laboratory will be under the immediate care of Mr. B. H. Van Vleck, Assistant in the Museum and Laboratory of the Boston Society of Natural History, a thoroughly competent instructor, and one who has also had long experience in collecting and observing at the sea-side.

II, A, 9

Announcement of the last session of the Annisquam Laboratory, 1886, copied from the original.

Boston Society of Natural History
Berkeley, Corner of Boylston St.

ANNISQUAM LABORATORY

The liberality and co-operation of the Woman's Education Association enable the Boston Society of Natural History to announce that the Sea-side Laboratory, at Annisquam, Mass., will be open to students during the coming summer from June 15 to August 15, 1886.

Annisquam is situated on an inlet of Ipswich Bay, on the north side of Cape Ann, and is about three and a half miles by coach from the Eastern Railroad station in Gloucester.

The purpose of the Laboratory is to afford opportunities for the study of the development, anatomy, and habits of common types of marine animals, under suitable direction and advice. There will therefore be no attempt to give lectures or any stated courses of instruction.

The Laboratory has been in operation for five successive summers and has fairly met the wants of a number of students, teachers and investigators. Those who have had some experience in a Laboratory, who have attended practical lessons, or who have taught in the schools are sufficiently qualified to make use of this opportunity.

The instruction and work of the Laboratory will be under the immediate care of Mr. B. H. Van Vleck, assistant in the Laboratory of the Boston Society of Natural History, a gentleman well known as a teacher, and who has also had long experience in collecting and observing at the sea-side.

A windmill which supplies running salt water, enables the Laboratory to offer opportunities for the study of living animals and also facilities for original observations and investigations.

Collecting implements, and row-boats are provided.

Students will find it to their advantage to provide themselves with a microscope. A convenient magnifying-glass and a case of dissecting instruments will be furnished at reduced prices to those ordering them beforehand.

Terms:—$3.00 per week for periods of two weeks or less, $1.50 per week for periods of three or four weeks, and $1.00 per week for all periods exceeding one month.

Board and rooms in the neighborhood can be obtained at prices varying from $5.00 or $7.00 to $10.00 per week.

Applications should be made immediately, and can be addressed to the undersigned.

Applicants should state particularly what previous instruction they have received, what *work* they have done, and how many weeks they propose to stay.

Alpheus Hyatt,
Curator.

APPENDIX TO CHAPTER III

III, A, 1

Articles of incorporation of the Marine Biological Laboratory.

No. 3170. March 20, 1888

COMMONWEALTH OF MASSACHUSETTS.

BE IT KNOWN, That whereas Alpheus Hyatt, William Stanford Stevens, William T. Sedgwick, Edward G. Gardiner, Susan Minns, Charles Sedgwick Minot, Samuel Wells, William G. Farlow, Anna D. Phillips, and B. H. Van Vleck have associated themselves with the intention of forming a Corporation under the name of the Marine Biological Laboratory, for the purpose of establishing and maintaining a laboratory or station for scientific study and investigations, and a school for instruction in biology and natural history, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer, and Trustees of said Corporation, duly approved by the Commissioner of Corporations, and recorded in this office;

Now, therefore, I, HENRY B. PIERCE, Secretary of the Commonwealth of Massachusetts, *do hereby certify* that said A. Hyatt, W. S. Stevens, W. T. Sedgwick, E. G. Gardiner, S. Minns, C. S. Minot, S. Wells, W. G. Farlow, A. D. Phillips and B. H. Van Vleck, their associates and successors, are legally organized and established as, and are hereby made, an existing Corporation, under the name of the MARINE BIOLOGICAL LABORATORY, with the powers, rights, and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed, this twentieth day of March, in the year of our Lord one thousand and eight hundred and eighty-eight.

HENRY B. PIERCE,
Secretary of the Commonwealth

[*Seal*]

III, A, 2

Original by-laws of the Marine Biological Laboratory (1888).

1. The annual meeting of the members shall be held in Boston on the fourth Wednesday of January in each year, at such time and place as shall be designated by the Trustees; and at such meeting the members shall choose by ballot a Clerk, Treasurer, and seven Trustees, who shall hold their offices for one year, and until others are chosen and qualified in their stead.

2. Special meetings of the members may be called by the Trustees to be held in Boston at such time and place as they may designate.

3. The Clerk shall give notice of meetings of the members by publication in some

daily newspaper published in Boston at least seven days before such meeting, and in case of a special meeting the notice shall state the purpose for which it is called.

4. Ten members shall constitute a quorum at any meeting.

5. The Trustees shall have the control and management of the affairs of the Corporation; they shall present a report of its condition at every annual meeting; they shall elect one of their number President, and may choose such other officers and agents as they may think best; they may fix the compensation and define the duties of all the officers and agents, and may remove them, or any of them, except those chosen by the members, at any time; they may fill vacancies occurring in any manner in their own number or in any of the offices. They shall from time to time elect members upon such terms and conditions as they may think best.

6. Meetings of the Trustees shall be called by the President, or by any two Trustees, and the Clerk shall give notice thereof by written or printed notice sent to each Trustee by mail, postpaid. Four Trustees shall constitute a quorum for the transaction of business.

7. The President shall, annually, in the month of February, appoint one Trustee who, with the President, shall constitute a committee on finance to examine from time to time the books and accounts of the Treasurer, and to audit his accounts at the close of the year. No investments of the funds of the Corporation shall be made by the Treasurer, except approved by the finance committee in writing.

8. The consent of every Trustee shall be necessary to a dissolution of the Marine Biological Laboratory. In case of dissolution, the property shall be given to the Boston Society of Natural History, or some similar public institution, on such terms as may then be agreed upon.

9. These by-laws may be altered at any meeting of the members, provided that the notice of such meeting shall state that an alteration of the by-laws will be acted upon.

III, A, 3

First "Annual Announcement" of the Marine Biological Laboratory, 1888.

THE MARINE BIOLOGICAL LABORATORY.

Incorporated in 1888.

FIRST SEASON. 1888.

Director, C. O. WHITMAN, Ph.D. Instructor, B. H. VAN VLECK, S.B.

THE new Laboratory is at Wood's Holl, Massachusetts. A convenient site has been secured close to the shore and to the laboratories of the United States Fish Commission. The Laboratory building consists of two stories: the lower story for the use of students receiving instruction, the upper story exclusively for investigators. The Laboratory will have boats, dredges, and other collecting apparatus; it will also be supplied with running sea-water, with alcohol, and other reagents, glass-ware, microtomes, aquaria, etc., a limited number of microscopes for students' use, and a small reference library.

The Laboratory for Students will be opened on TUESDAY, JULY 17th, at 9 A.M., for a systematic course of six weeks in zoölogy. By permission of the Director students may

continue their work until September 20th, without additional payment. Microscopes, glass-ware, etc., will be supplied without extra charge except for breakage. Hand lenses, dissecting instruments, drawing materials, etc., may be bought at cost in the Laboratory. It is desired that students owning microscopes should bring them.

The fee for this course is twenty-five dollars ($25), payable in advance. The number of students will be limited to twenty-five.

The Laboratory for Investigators will be opened on JULY 10th, and will be closed on September 22d. It will be equipped as fully as the means permit. Microscopes will not be provided, but it is believed that investigators will find most of their indispensable wants satisfied. The fee for an investigator's table will be fifty dollars ($50) for the present season.

Rooms accommodating two persons may be obtained near the Laboratory at prices varying from $3.00 to $4.00 per week, and board from $4.50 to $7.00. Mr. Joseph S. Fay has kindly put at the disposal of the trustees Gardiner Cottage, a small house not far from the Laboratory. In this cottage first-class table-board will be supplied to students at $5.00 per week.

Wood's Holl, owing to the richness of the marine life in the neighboring waters, offers exceptional advantages. It is situated on the north shore of Vineyard Sound, at the entrance to Buzzard's Bay, and may be reached by the Old Colony Railroad (2½ hours from Boston), or by rail and boat from Fall River and New Bedford. Persons coming by the way of Boston should buy round-trip tickets ($2.85).

The new Laboratory is intended to continue and extend the work of the Laboratory at Annisquam, carried on for six years by the Woman's Education Association, with the co-operation of the Boston Society of Natural History.

[*Signed by the Trustees.*]

ALPHEUS HYATT, PRESIDENT ..... Boston Society of Natural History.
FLORENCE M. CUSHING ..... 8 Walnut Street, Boston, Mass.
EDWARD L. MARK ..... Harvard University, Cambridge, Mass.
SUSAN MINNS ..... 14 Louisburg Square, Boston, Mass.
CHARLES S. MINOT ..... Harvard Medical School, Boston, Mass.
WILLIAM T. SEDGWICK ..... Massachusetts Institute of Technology, Boston.
SAMUEL WELLS, ESQ. ..... 31 Pemberton Square, Boston, Mass.

III, A, 4

BY-LAWS OF THE CORPORATION OF THE MARINE BIOLOGICAL LABORATORY[1]

I. The annual meeting of the members shall be held on the second Tuesday in August at the Laboratory in Wood's Holl, Mass., at 12 o'clock noon in each year, and at such meeting the members shall choose by ballot a Clerk, who shall be *ex officio* a member of the Board of Trustees, and Trustees as hereinafter provided. At the annual meeting to be held in 1897, not more than twenty-four Trustees shall be chosen, who shall be divided into four classes, to serve one, two, three and four years respectively, and thereafter not more than six Trustees shall be chosen annually for the term of four years. These officers shall hold their respective offices until others are chosen and qualified in their stead. The Director and Assistant Director, who shall be chosen by the Trustees, shall also be Trustees *ex officio*.

[1] As amended at the annual meeting, August 24, 1897, with minor changes to 1899.

II. Special meetings of the members may be called by the Trustees, to be held in Boston or in Wood's Holl at such time and place as may be designated.

III. The Clerk shall give notice of meetings of the members by publication in some daily newspaper published in Boston at least fifteen days before such meeting, and in case of a special meeting the notice shall state the purpose for which it is called.

IV. Fifty members shall constitute a quorum at any meeting.

V. The Trustees shall have the control and management of the affairs of the Corporation; they shall present a report of its condition at every annual meeting; they shall elect one of their number President, and may choose such other officers and agents as they may think best; they may fix the compensation and define the duties of all the officers and agents; and may remove them, or any of them, except those chosen by the members, at any time; they may fill vacancies occurring in any manner in their own number or in any of the offices. They shall from time to time elect members to the Corporation upon such terms and conditions as they may think best.

VI. Meetings of the Trustees shall be called by the President, or by any two Trustees, and the Secretary shall give notice thereof by written or printed notice sent to each Trustee by mail, postpaid. Seven Trustees shall constitute a quorum for the transaction of business. The Board of Trustees shall have the power to choose an Executive Committee from their own number, and to delegate to such Committee such of their own powers as they may deem expedient.

VII. The President shall annually appoint two Trustees who shall constitute a committee on finance to examine from time to time the books and accounts of the Treasurer, and to audit his accounts at the close of the year. No investment of the funds of the Corporation shall be made by the Treasurer except approved by the finance committee in writing.

VIII. The consent of every Trustee shall be necessary to a dissolution of the Marine Biological Laboratory. In case of dissolution, the property shall be given to the Boston Society of Natural History, or some similar public institution, on such terms as may then be agreed upon.

IX. These By-Laws may be altered at any meeting of the members, provided that the notice of such meeting shall state that an alteration of the By-Laws will be acted upon.

X. Any member in good standing may vote at any meeting, either in person or by proxy duly executed.

III, A, 5

Trustees of the Marine Biological Laboratory, 1899, from the "Ninth Annual Report."

TRUSTEES—1899

President,

H. F. Osborn

Members ex officio

C. O. Whitman, *Director*, University of Chicago, Chicago, Ill.

U. Dahlgren, *Assistant Director*, Princeton University, Princeton, N.J.

E. G. Gardiner, *Clerk of the Corporation*, 131 Mt. Vernon St., Boston, Mass.

To Serve Till 1903.

H. C. Bumpus . . . . . Brown University, Providence, R.I.
D. B. Hoar, *Treasurer* . . . . . 220 Devonshire St., Boston, Mass.
W. A. Locy . . . . . Northwestern University, Evanston, Ill.
J. Loeb . . . . . University of Chicago, Chicago, Ill.
J. M. Macfarlane . . . . . University of Pennsylvania, Philadelphia, Pa.
F. P. Mall . . . . . Johns Hopkins University, Baltimore, Md.

To Serve Till 1902.

E. G. Conklin . . . . . University of Pennsylvania, Philadelphia, Pa.
C. G. Kidder . . . . . 27 Williams St., New York, N.Y.
M. M. Metcalf . . . . . The Woman's College, Baltimore, Md.
W. Patten . . . . . Dartmouth College, Hanover, N.H.
D. P. Penhallow . . . . . McGill University, Montreal, Canada
W. B. Scott . . . . . Princeton University, Princeton, N.J.

To Serve Till 1901.

S. F. Clarke . . . . . Williams College, Williamstown, Mass.
J. P. McMurrich . . . . . University of Michigan, Ann Arbor, Mich.
T. H. Morgan . . . . . Bryn Mawr College, Bryn Mawr, Pa.
L. L. Nunn . . . . . Telluride, Col.
H. F. Osborn, *President* . . . . . American Museum of Natural History, New York, N.Y.
E. B. Wilson . . . . . Columbia University, New York, N.Y.

To Serve Till 1900.

W. K. Brooks . . . . . Johns Hopkins University, Baltimore, Md.
W. Libbey . . . . . Princeton University, Princeton, N.J.
W. T. Sedgwick . . . . . Massachusetts Institute of Technology, Boston, Mass.
W. Trelease . . . . . Missouri Botanical Gardens, St. Louis, Mo.
W. P. Wilson . . . . . Philadelphia Museums, Philadelphia, Pa.
R. R. Wright . . . . . University of Toronto, Toronto, Canada

III, A, 6

By-laws proposed under the offer of President W. R. Harper, of the University of Chicago, from the minutes of the meeting of the trustees of the Marine Biological Laboratory held on January 2, 1902.

PROPOSED NEW BY-LAWS OF THE MARINE BIOLOGICAL LABORATORY

MEMBERSHIP.

Article I. The members of this corporation shall be of two classes, to be known as Class A and Class B respectively.

Section I. Membership of Class A is fixed at fifteen in number, and the members belonging to this class shall constitute the Board of Trustees of this corporation.

Section II. Membership of Class B: Any person may become a member of Class B upon the written approval of a majority in number of the Scientific Council, provided he shall have paid two dollars in advance; and shall continue to promptly

pay annual dues of two dollars, or such other amount as may be fixed by the Scientific Council.

Any person may become a life member of Class B upon the written approval of a majority in number of the Scientific Council, by the prepayment of the sum of one hundred dollars ($100). Any person making a gift of one thousand (1000) dollars or more shall be enrolled as a patron.

BOARD OF TRUSTEES.

Article II. Members of Class A: At a meeting of the Trustees to be held in the State of Massachusetts, January 11, 1902, or thereabouts, the members of the Trustees shall elect four members of Class A, and these, together with the Director of the Laboratory (a member ex officio), shall be the only original members of this Class. But members of Class A once elected may elect others to membership in the same Class, provided that not more than fifteen in all shall ever belong to this class at the same time.

The Trustees shall hold and control all lands, buildings, revenue and property of whatever description now belonging to, or hereafter acquired by, the Marine Biological Laboratory. The title of all the property of the Laboratory, both real and personal, shall be vested in them, and they shall sustain to its work the relation which is ordinarily sustained to an institution of learning by a Board of Trustees.

They shall have entire control and management of the finances of the corporation and the power of amending its By-laws, subject to the approval of the Scientific Council. They shall elect one of their number President of the Board of Trustees, who shall also be President of the Scientific Council. They shall also choose a Director of the Laboratory, upon the nomination of the Scientific Council, and an Assistant Director (who shall be nominated by the Director), and these three shall be ex officio members of the Scientific Council. The Board of Trustees shall elect a Treasurer and prescribe his duties. It shall fill vacancies of the Board, as they may occur from time to time, and shall make such rules as to meetings and conduct of business, as they may deem wise.

DIRECTOR OF THE LABORATORY.

Article III. Director of the Laboratory: The Director of the Laboratory shall have the right to nominate to the Trustees, the Assistant Director and members of the Scientific Staff of the Laboratory, and shall appoint the collecting staff and all employees, expressly subject, however, to the limits imposed by the appropriations made for these purposes from time to time by the Trustees. He shall have the direction of the conduct and policy of the Laboratory, and shall be responsible therefore only to the Trustees.

He shall present a written report annually to the Scientific Council at their annual meeting for transmission to the Board of Trustees. This report shall cover the attendance at the Laboratory, specifying the work done, and making any desired recommendations.

He shall be a member of the Board of Trustees ex officio.

SCIENTIFIC COUNCIL.

Article IV. The Scientific Council shall consist of the twenty-eight persons who constituted the Board of Trustees under the By-laws in force during the last half of the year 1901, until the second Tuesday in August, 1902, at which time the Council shall

elect eight persons to serve four years, of whom six shall be to fill the vacancy caused by the expiration of the term of those heretofore elected by the Corporation and whose term expired on that date, and on the second Tuesday in August, 1903, the Council shall elect eight to serve four years, of whom six shall be to fill the vacancy caused by the expiration of the term of those heretofore elected by the Corporation, and whose term expired on that date. Hereafter at an annual meeting of the Council, to be held on the second Tuesday of August of each year, the Council shall elect not more than eight persons to serve for a period of four years. The President, Director and Assistant Director shall be members of the Council ex officio, but other members of Class A shall be ineligible.

They shall fill vacancies in their own number, and shall hold office until others are chosen and qualify in their stead.

Seven members shall constitute a quorum.

The Council have the right to nominate the Director, and shall approve changes in the By-laws before the same shall become operative. The functions of the Council shall be otherwise advisory.

The Council shall elect from their own number a clerk who shall give notice of all meetings of the Scientific Council, and shall keep a record of meetings and of all matters of which a record shall be deemed advisable by the Scientific Council. He shall have charge of the correspondence and documents of the Council, and his records shall at all reasonable times be open to the inspection of any members of the Council and Trustees. He shall notify new members of their election.

MEETINGS OF THE SCIENTIFIC COUNCIL.

Article V. The annual meeting of the Scientific Council shall be held in Wood's Holl, Mass., on the second Tuesday in August in each year; but the Scientific Council may make rules concerning the holding of special meetings.

AMENDMENTS TO BY-LAWS.

Article VI. These By-Laws may be amended by the Trustees at any meeting of which at least two weeks' notice in writing shall have been given, stating that an amendment or amendments to the By-Laws are to be acted upon, and specifying in general terms the character of the proposed amendments; provided that the changes shall not become operative, except by the approval of the Scientific Council at an annual meeting, or a meeting specially called for that purpose.

III, A, 7

Report of the Conference Committee of the Marine Biological Laboratory to the trustees, transmitted by E. B. Wilson and H. F. Osborn.

NEW YORK, March 14th, 1902.

TO THE TRUSTEES OF THE MARINE BIOLOGICAL LABORATORY;

As chairman of the conference committee appointed by the executive committee of the trustees of the M. B. L. at their meeting February 1st, for the purpose of conferring with the executive committee of the Carnegie Institute, I desire to offer the following informal statement on the action of our committee and to ask your attention to the matters which will come before the trustees at their coming meeting, in New

York, on March 22nd. Professor Osborn and myself, acting for the committee, placed before the executive committee of the Carnegie Institute all the principal facts regarding the past history and present status of the laboratory, and asked their consideration of the following three points.

First: The general question whether the Carnegie Institute would support the Marine Biological Laboratory with the intention of placing it on a permanent basis as a representative national research laboratory.

Second: The specific question of support for the laboratory for the coming summer.

Third: The best practicable organization of the laboratory that would commend itself to the Carnegie Institute as an assurance of its national representative character.

These points were considered at a meeting of the executive committee of the Carnegie Institute held in New York on March 11th, at which all the papers in connection with the Wood's Hole business were referred to Dr. J. S. Billings, as a special committee to consider the matter and report, with his recommendations, at the meeting of the Carnegie Committee on Tuesday, March 25th. By invitation of Dr. Billings, I met him and discussed the matter thoroughly on March 13th with the following result.

Dr. Billings has given me the assurance that the Carnegie Institute stands ready to place the laboratory upon a permanent basis, to purchase land, erect and equip a new laboratory, and to make suitable provision both for the research work and for the publications of the laboratory, with the understanding "that the primary object of the laboratory is to promote original research and to give competent persons an opportunity to make such research, and that it is not of the nature of a school for the teaching of ordinary students." He is not at present able to make any exact statement as to the sum that will be contributed for this purpose, but expressed the private opinion that they would probably expect to expend not less than $75,000.00 for the building and equipment of the laboratory, and an annual appropriation of not less than $10,000.00 for its support. His ideas of the scope and character of the work to be carried on at Wood's Hole are of the broadest and most progressive kind, and he assures me that if they undertake the establishment of the laboratory, it will be in such a way as to challenge comparison with the best existing marine laboratories in the world. Professor Osborn and myself are convinced that if the laboratory is placed under the Carnegie control its future is assured on a splendid and permanent basis, and that we have now the opportunity to develop the institution into one of the highest rank and to render a great and lasting service to the cause of American science.

This action of the Carnegie Institute will, however, be contingent upon the transfer of the laboratory property to the trustees of the Carnegie Institute, so that it shall be incorporated with the Institute as "one of the special features" of their proposed plan for the encouragement of scientific research. Without having worked out the details of a plan of organization, Dr. Billings expressed to me the opinion that the affairs of the laboratory should be directly controlled by an advisory council representative of the universities and similar to the existing board of trustees, or to the scientific council proposed under the reorganization scheme that was considered last summer. He suggested that this council should have the power of choosing the director, subject to the approval of the Carnegie committee, and of administering the general affairs of the laboratory with the funds provided by the Carnegie Institute.

The Carnegie committee is, however, not ready to recommend this plan to their trustees until they receive the assurance that the present trustees are entirely free to make the transfer and have not committed themselves to the pending reorganization plan. Owing to their still incomplete organization they are, furthermore, not in a position to offer large financial support for the present summer, and cannot promise more than the sum of $4,000.00. To this extent they are ready to contribute to the laboratory as an emergency fund for the present summer, and they would be glad to be joined in this by contributions from other friends of the laboratory. One such friend has already been found in New York, and it is hoped that some at least of the members of the proposed new board of trustees who are already members of the present board may be willing to make the same contribution that was contemplated under the pending reorganization plan.

The members of the proposed new board have been given an opportunity to confer with Dr. Billings in case they so desire. I would respectfully urge upon the trustees of the laboratory the great importance of attending the coming meeting, so that as full an expression of opinion as possible may be obtained upon the question before us, which involves the whole future of the institution. I would also suggest the great desirability that members who are unable to attend the meeting should send to the Secretary, Dr. E. G. Gardiner, or to me, a written statement of their opinion of the questions that may be submitted to the meeting.

Edmund B. Wilson,
(*Chairman of the Executive Committee and of the Conference Committee*)
Henry F. Osborn.

III, A, 8

Resolutions passed by the Executive Committee of the Carnegie Institution at a meeting in New York City, March 25, 1902.

1. *Resolved:* That the acquirement of the Woods Hole Laboratory by the Carnegie Institution, with the understanding that the Trustees of the Laboratory are willing to turn over its plant to this Institution, provided the latter will undertake the maintenance and support of the Laboratory, is approved by the Executive Committee, and that such action will be recommended to the Board of Trustees at its meeting in November next as part of the report on the general scope and plan of the work of the Institution.

2. *Resolved:* That a special committee consisting of John S. Billings, A. S. Hewitt and S. Weir Mitchell is appointed for the consideration of all matters connected with plans for research and instruction in the Department of Marine Biology, to which committee all communications relating to this department of scientific work shall be referred.

3. *Resolved:* That this committee is requested to confer with the Trustees of the Woods Hole Laboratory for the preparation of a plan in detail for the organization of the Laboratory and its work, said plan to be reported to the Executive Committee.

4. *Resolved:* That if satisfactory evidence is furnished to the Executive Committee

that the Trustees of the Woods Hole Laboratory have full power to transfer the property of the Laboratory to the Carnegie Institution, and have agreed to do so, the sum of $4,000 payable on or after August 1st, 1902, be, and the same is hereby, granted from the funds of the Carnegie Institution to the Trustees of the Woods Hole Laboratory as a contribution towards the expenses of the Laboratory for the coming summer.

III, A, 9

Statement made by Dr. C. O. Whitman to the trustees of the Marine Biological Laboratory, April 27, 1902.

You will be interested to know what the Conference Committee have, and have not, done. On Friday, 4 P.M., April 11, we had a meeting in New York, and all six members were present. The situation was freely discussed, and in good temper. As we knew beforehand, we were equally divided in opinion, Wilson, Herter and Hoar against Crane, Nunn and Whitman. Wilson, Herter and Hoar were for accepting the Billings proposition outright and at once. Neither of them had a word in favor of any attempt to secure co-operation. Crane, Nunn and I urged the importance of combining both proposed supports, on an independent basis, if possible. For a permanent staff, continuous work, publications, etc., the Laboratory would require at least $20,000.00 at the start; and $30,000.00 to $40,000.00 would scarcely be adequate for doing what we are already well prepared to do. We could not therefore afford to lose either support; and every true friend of the Laboratory must see the wisdom of trying to secure both.

Crane maintained strongly that outside support would be cut off if the Laboratory were given to an institution bearing Carnegie's name, citing in illustration the Field Columbian Museum, which gets no support except from Mr. Field, and the University of Chicago, which receives from others about as much as it gets from Mr. Rockefeller. Crane said one thing particularly appropriate at this time: "*The M.B.L. is worth more than all Carnegie's millions.*"

It was pointed out that the Billings proposition required complete surrender of the Laboratory, while offering in return only the same support as was promised by the proposed new board. The reply was that the Carnegie support rested on a permanent endowment. This was the only argument adduced in its favor. Conceding this point (security of income), I claimed that it had the fatal disadvantage pointed out by Mr. Crane; and, that the new board carried the same security, inasmuch as it was to be a self-perpetuating body. The new board would have, moreover, the following distinct advantages:

1. It would be a board of our own, and would conserve our independence.
2. It would soon become a board of five or seven members, and thus would be able to double or treble the sum promised for the first year.
3. It would invite and encourage outside support.
4. It would tend to increase college co-operation.
5. It would leave the power of changing the By-laws in the hands of the scientific Council.
6. It would have the Laboratory as its sole interest; it would have only active members; it would be sympathetic and approachable.

Mr. Nunn pointed out with great force that "*the Carnegie proposition did not mean*

they were to give us anything, but that we were to give them everything. They had not proposed to give us an endowment for the Laboratory, but to keep the endowment themselves, while asking us to give them the Laboratory. Our compensation was to be the *privilege of work* at the Laboratory, under their patronage."

The Laboratory and all its belongings would pass out of the hands of those who have made and owned it into the hands of the Carnegie board, who have absolutely no claim to it, not even the claim that would go with an offer to aid it without ownership, or with co-operative ownership. The only palliating apology for such a proposition is found in Mr. Hewitt's remarks, given below. It is the humiliating fact that the proposition did not originate with the Carnegie people, but in the suggestions of some of our own trustees. *We* supplicate to give; *they* consent to take. This is, indeed, a brilliant performance, unsurpassed even in fable.

Mr. Crane suggested that it might be safer for us to reserve our decision for a year or more, until we had an opportunity to see how the Carnegie Institute was to develop, meanwhile making use of the funds supplied by the proposed new board. The new board, he said, would of course be ready to resign whenever in the opinion of the Council, its services were not needed.

Wilson and Herter repeatedly insisted that our Trustees at their last meeting had voted unanimously for accepting the Carnegie support, and that the main question had thus been definitely decided.

This was not my understanding of the votes passed at the meeting of the Trustees, March 22nd. I offered two resolutions at that meeting (accepted without dissent) which were intended, not to bind us irrevocably, but to prepare the way for *securing co-operation in the support of the Laboratory.* The Conference Committee included two members of the proposed new board, Messrs. Nunn and Crane, and they were appointed with this end especially in view. My thought was—and I think most of the Trustees were of the same mind—that we could safely vote for the Carnegie support, and then work through the Conference Committee for a combination of the two supports. If one support is welcome, double the support could not be less welcome.

If we committed ourselves to the Carnegie support, we certainly committed ourselves in a more binding fashion to the new board at the Chicago meeting. We have *approved* of both supports, and have actually *accepted* the new board, as the records show. The truth is, however, that we are still free to refuse or accept either or both supports.

I called on Dr. Billings immediately after the meeting of March 22nd, in company with Wilson and Herter, and our resolutions were read to him. He made it very clear to us that we could take all summer to consider the question, that there was no need of haste as the Carnegie Trustees would not act until next November.

Such was the course of argument and suggestion at our meeting, April 11.

Saturday morning at 10:30, we had a joint meeting with Dr. Billings and Mr. Hewitt, who, with Dr. Mitchell (absent), represented the Carnegie Executive Committee.

We were told that, if the Laboratory were given over to the Carnegie Trustees, they did not intend to make any change or interfere at all with the management of the Laboratory; but, they said, of course the power will be in the hands of the Carnegie Trustees, and they could, if so disposed, sweep away the by-laws and make new ones. Both Hewitt and Billings reiterated this warning.

When we asked about the possibility of an independent board, representing fairly both supports, Mr. Hewitt remarked: "That is an entirely new proposition. We have not considered it. It was not presented to us in that light. We were asked if *we would take the Laboratory and support it*. We were told that there was an emergency that made it necessary to act now. There was important land to be purchased now at a reasonable price, which might be obtained only at a much higher price later, if at all. If we had been asked, in the first place, to contribute to the support of the Laboratory, we should probably have much preferred to do that to taking the whole responsibility." This, in substance, was repeated twice.

Dr. Billings was asked if he would advise the Carnegie Trustees to contribute financial support to the Laboratory, without owning it.

He replied substantially as follows: "We should probably be willing to contribute $5000.00 or even $10,000.00 a year, but such a contribution might not be a constant one. It would be made in the form of a grant for one, three, or at most five years, and possibly it might be renewed."

Then Dr. Herter said he wished to put himself *on record* as heartily in favor of surrendering the Laboratory to the Carnegie Trustees, and Dr. Wilson also declared himself in the same way, and referred to our resolutions of March 22nd as proof that the Trustees of the M.B.L. had unanimously voted in favor of this step. I did not think it best at the time to show that he was overstating the facts, but I afterwards reminded him that we *all* wished to see our two supports united, and that we voted as we did because we believed that to be the best way to secure both supports.

As they were returning to the Holland House, I told Dr. Wilson that I was much disappointed that neither he nor Dr. Herter had said a word in favor of co-operation. I told him I was astonished to learn that no effort had been made to secure both supports. It was perfectly plain, I continued, that the plan of the new board had not received fair treatment. Wilson tried to break the force of Hewitt's remarks by saying that Hewitt merely meant that Billings had not presented the plan of co-operation with the new board. In other words, Billings was responsible for the plan of *owning* the Laboratory. Wilson and Osborn, I was left to infer, were not responsible.

I confess that I felt a little more than disappointed to learn that the whole affair, from the beginning, had been conducted in a way to preclude, so far as possible, any plan of united action on an independent basis. The already accepted plan of a new board had been treated as an "alternative," as a "last resort."

Is it possible that the independence of the Laboratory, so precious to us as long as it was a bar to affiliation with any university, now ceases to have any meaning or value the moment we are in sight of possible absorption in the Carnegie Institute? We have been sorely pressed with the trials of poverty, but hitherto we have never failed to rally with courage equal to any danger that threatened to undermine or restrict our independence. We could not tolerate the intrusion of external and sectional domination in any part of our organization, and the Corporation, on one notable occasion, recorded a vote best summarized in the one word, independence.

After devoting fourteen years to the development of the Laboratory, with independence and co-operation as our watch-words, I am not now easily convinced that independence can be safely exchanged for endowment. Money may purchase co-operation of a venal kind, but it can never supply the essential thing, namely, the

co-operative spirit. That is a plant with roots too deeply and firmly fixed in independence to long survive its loss.

The present crisis is not one for hasty action; it is one, rather, to inspire confidence, firmness, and fidelity to the principles that have guided us in the past and led us to the splendid opportunities of the present. Within a single year, we have seen three promising schemes of support proposed:

1. University Co-operation, providing an annual income of several thousand dollars.

2. A New Board of Trustees, responsible for a $10,000.00 donation yearly, for a new Laboratory, purchase of land, and the funds required for a permanent staff, continuous work, publications, etc.

3. The Carnegie Institute offer, providing $75,000.00 for a Laboratory and equipment, $10,000.00 a year for expenses of work, publications, etc.

This luxury of opportunities, all developed to the point where it only remains for us to say which, or how many, we will accept, gives the strongest assurance of financial support in the future, and relieves us of all anxiety on this point. We may keep the Laboratory and be sure of steady and strong support, given freely for its own sake, requiring no surrender of property or control, or we may sell it for an endowed income, relieve ourselves of financial responsibility, and at the same time the Laboratory of its independence and all that implies.

This is the situation as I see it.

We closed on Saturday with a dinner at the Holland House. At the last moment Wilson again proposed that our committee recommend that the Trustees accept the offer made through Billings and that they do this immediately.

I replied:—"We are not ready for final action. The Carnegie Committee have made it clear that there is no need of haste. We have all summer to reflect and decide. Dr. Billings is coming to Wood's Holl in June, and we shall have an opportunity to talk matters out in detail. Don't think of calling any more meetings until we reach Wood's Holl." To this all seemed to assent, and so the matter was left.

I shall be glad to receive any criticism and suggestions.

Very truly yours,

C. O. Whitman

III, A, 10

Second report of the Conference Committee of the Marine Biological Laboratory to the trustees, June 1902.

To the Trustees of the Marine Biological Laboratory:

The Undersigned, members of the Conference Committee appointed at the New York meeting of the Trustees, March 22nd, respectfully offer the following report:

The resolutions under which the committee was appointed were as follows:

1. *Resolved* That the Trustees approve the incorporation of the Marine Biological Laboratory by the Carnegie Institution on the lines indicated in the letter of Dr. Billings, and that the chair appoint a committee of six, including himself, to confer with the Executive Committee of the Carnegie Institution and make such arrangements as are deemed advisable and necessary regarding the legal incorporation, the

personnel of the new board and the manner of conducting the laboratory in the future. This committee to report to the present board for final action as soon as practicable.

2. *Resolved* That it is the sense of this meeting that it is desirable that the incorporation be so conducted as to leave open and invite the co-operation of the present friends and supporters of the laboratory and others.

The committee appointed under the first of these resolutions consisted of Messrs. Whitman, Crane, Nunn, Hoar, Herter and Wilson. Copies of the two resolutions were transmitted to the Executive Committee of the Carnegie Institution and were considered at a meeting of that committee in New York, March 25th, when a set of resolutions were passed (copy enclosed) approving the "acquirement of the Wood's Hole Laboratory by the Carnegie Institution, with the understanding that the trustees of the Laboratory are willing to turn over its plant to the Institution, provided the latter will undertake the maintenance and support of the laboratory." A special committee consisting of John S. Billings, A. S. Hewitt and S. Weir Mitchell was appointed for the consideration of the matter.

At a conference subsequently held by Messrs. Kidder and Wilson with Dr. Billings to ascertain under what conditions the transfer might be effected, a preliminary sketch of new by-laws embodying these conditions was drawn up and approved by Dr. Billings. This sketch was laid before a full meeting of the Conference Committee (Messrs. Whitman, Crane, Nunn, Hoar, Herter and Wilson present), held in New York on April 11th, and on the following day the Committee (Mr. Hoar absent) met and discussed the matter with Messrs. Billings and Hewitt of the Carnegie Committee. In the course of this conference the Carnegie representatives were asked whether they would accept a joint board of trustees equally representing the Carnegie Institution and the existing Board of Trustees of the M.B.L. This proposition was not accepted by Messrs. Billings and Hewitt who stated in substance that it was not the policy of the Carnegie Institution to enter into organic alliance with existing institutions in such a manner as to involve divided control; that the Institution might from time to time make special grants to the M.B.L. as a separate and independent institution as it might to other institutions or individuals; but that permanent and continuous support involving the purchase of land, erection and equipment of buildings and the regular contribution of funds for running expenses could only be promised to the laboratory on condition of a definite and complete transfer of the property to the Institution, so that it might assume full financial control and responsibility. They stated very positively at that time and subsequently, that it was the wish and intention of the Carnegie Institution upon assuming control of the laboratory to give the managers the fullest possible scientific independence and freedom, and not to interfere with either the general scientific policy or the details of the management.

Accepting these as fundamental conditions the members of the committee subsequently gave their careful consideration to the proposed by-laws, and finally again met Messrs. Billings and Hewitt at a meeting held in New York on May 31st, Messrs. Crane, Hoar and Wilson being present, and also Professor Lillie (representing Professor Whitman, who was unable to be present) and Dr. Gardiner, the secretary of the Board, who will act for Professor Wilson during his absence in the south.

In order to place the outcome of these negotiations clearly before the trustees,

separate copies are enclosed, (*a*) of the preliminary sketch of by-laws that formed the basis of our consideration and discussion, and (*b*) of the modifications recommended or suggested by your committee.

It has been the aim of the Trustees to retain with as little change as possible under the Carnegie reorganization those features of the present organization and policy of the laboratory that seem to them to have been potent factors in its effectiveness and success heretofore. Foremost among these, we believe, has been its representative and co-operative character and its independence of local control. The Trustees believe that the maintenance of this character under the Carnegie reorganization is guaranteed in the by-laws by paragraph 1, which provides for a representative scientific Board of Managers (to be constituted at the start by the present Board of Trustees); and by paragraphs 6 and 11, which give this Board the power to manage the laboratory, to appoint and define the duties of the Director and other officers, and in general to take charge of the scientific work, subject only to the limits of the appropriations made by the Carnegie Institution and of income from other sources. Attention is called to the very broad scope of paragraph 11, which is considered of especial importance as giving the Board of Managers full power to make their own "rules and regulations" regarding all matters of scientific management, including the appointment of the Director and other officers, the definition of their duties and powers, and all other matters not specifically provided for in the by-laws. This gives to the Board substantially the same powers as those of the existing Board of Trustees, and renders unnecessary the insertion of various special by-laws which may be left to the "rules and regulations" of the Board. The committee is somewhat in doubt as to whether it may not be desirable, nevertheless, to limit the powers of the Board in respect to certain matters by such special by-laws. The most important questions in this regard affect the mode of nomination of new members of the Board of Managers, the relation of the Director to this Board, and the functions of the present Corporation (in case this body is retained under the reorganization).

(1) Concerning the first of these questions: Some members of the committee consider it desirable to adhere as nearly as possible to the existing mode of procedure, by placing the power to nominate in the hands of the Corporation. The opinion of other members is that the Board of Managers should be made practically self perpetuating by giving them the right of nomination as provided for in paragraph 3 of the preliminary sketch.

(2) Concerning the second question: The relation of the Director to the Board of Managers, and his duties and powers, may be defined either by special by-laws, to be enacted by the Carnegie Institution, or by the Board of Managers as empowered by paragraph 11. The latter method is more elastic, leaves the Board freer, and commends itself more strongly to the majority of the members of the committee. The committee consider that the Director should be given large powers and the freest possible scope. They are unanimous that he should be *ex officio* chairman of the Executive Committee, and that he should have the right to nominate all other officers of the Laboratory and to appoint all employees. Some members of the committee are of the opinion that he should also be *ex officio* chairman of the Board of Managers, and that the office of President of the Board is unnecessary, believing that under the proposed new arrangement the independence of the Director would thus be ensured, and that as Manager in Chief of the Laboratory, he is the logical head of this Board. Such an

arrangement would also relate the Director in the closest possible manner to the Board of Trustees of the Carnegie Institution. Other members are inclined to consider it undesirable that the Director, who is an appointee of the Board, should also be its formal head; and believe that his executive freedom is assured by making him Chairman of the Executive Committee.

Apart from the above points the suggested modifications are only verbal or relate to matters of minor detail. The committee offers no suggestion as to the manner of legal transfer, considering this a matter of detail that will be adjusted without difficulty after the fundamental conditions of organization have been determined. These and other matters relating to the Carnegie reorganization plan will be considered at a coming meeting of the Trustees, to be held in the month of July, of which due notice will be given. It is hoped that at this meeting the matter may assume final shape, and that the necessary specific action may be recommended to the Corporation. In the meantime the committee would be glad to receive, through Dr. Gardiner or other members, any suggestions or expressions of opinion regarding the matters touched on in this report.

[*Signed*] Edmund B. Wilson, *Chairman*
Charles R. Crane
C. A. Herter
D. Blakely Hoar
L. L. Nunn
C. O. Whitman

III, A, 11

Preliminary sketch of by-laws proposed to be enacted by the Carnegie Institution, as revised July 19 and August 12, 1902.

1. The Marine Biological Laboratory, constituting the Department of Marine Biology of the Carnegie Institution, shall be under the general charge of a Board of Managers, consisting of not more than thirty-two persons to be elected by the Executive Committee of the Carnegie Institution and of whom at least one shall be a trustee of said Institution.

2. The Board of Managers shall be elected for the term of four years and shall be eligible for re-election. They shall be divided into four classes of eight each and at the first election to be held hereunder such classes shall be chosen for one, two, three and four years respectively, and thereafter each class shall be elected for the full term of four years.

3. The members of the Corporation of the Marine Biological Laboratory shall nominate to the Executive Committee of the Carnegie Institution persons recommended to fill vacancies, stating the order of preference.

4. The Board of Managers shall hold regular meetings on the second Tuesday in August in each year, and special meetings on the call of the Executive Committee or any five members, or of the Executive Committee of the Carnegie Institution.

5. No member of the Board of Managers shall receive any compensation for his services as such.

6. The Board of Managers shall have immediate charge of the Marine Laboratory at Woods Hole, Mass., and of all work and branches connected with it, and it shall

act as an advisory council to the Carnegie Institution on matters relating to research, instruction, or publications connected with biology referred to it by the Carnegie Institution.

7. The Board of Managers shall appoint the Director of the laboratory. They shall also appoint other necessary officers, who shall have the usual duties of such officers and shall hold office for one year, or until others are elected or qualified in their stead. They shall be eligible for re-election.

8. There shall be an Executive Committee, consisting of the Director, the Assistant Director, Secretary and two other members.

9. The Executive Committee shall carry out the orders of the Board of Managers and shall have such duties and powers as may be devolved upon them by the Board, including the general charge of all arrangements for administration, research and instruction; PROVIDED, that no expenditure shall be authorized or made by them except in accordance with a previous appropriation voted by the Board of Managers or by the Trustees or Executive Committee of the Carnegie Institution.

10. The Executive Committee of the Board of Managers shall make arrangements for the custody and disbursement of the funds of the Department; shall provide for an accurate account of all receipts and disbursements and shall submit to the Board of Managers at its annual meeting a full statement of the property of the Department with a detailed estimate for the expenditure of the ensuing year. These statements and reports, with such comments as may be deemed necessary, shall be forwarded to the President of the Carnegie Institution for presentation to its Executive Committee.

11. The Board of Managers shall make such rules and regulations with regard to the organization and management of the Department Laboratory and its dependencies as it may deem desirable, including the appointment, duties and salaries of its officers and employees, subject to these by-laws and within the limits of the appropriations made by the Carnegie Institution for the support of the Laboratory and other income.

12. The Board of Managers shall establish the rates of payment to be made by persons or corporations making use of the laboratory and is authorized to obtain, receive and disburse funds contributed for any purpose within the scope of the general purposes of the laboratory and to make such rules for the use of such gifts as may be agreed upon between the donors and the Board. Such gifts may be made for scholarships or fellowships—for the maintenance of special tables, for expeditions or branches, for special lines of research, for the library, or for any other purpose consistent with the objects of the Laboratory.

13. Gifts for current expenses may be administered by the management, but permanent endowments shall be paid over to the trustees of the Carnegie Institution and the income thereof be expended by the managers in accordance with the conditions of the donors or under such regulations as may, from time to time, be made by the Trustees of the Carnegie Institution. No indebtedness shall be incurred in excess of the appropriations made by the trustees of the Carnegie Institution and of cash from other sources.

14. Changes in the by-laws may be made on recommendation of the Board of Managers, and any proposed change shall be submitted to them for consideration and report and shall be acted upon by the Executive Committee of the Trustees of the Carnegie Institution.

III, A, 12

STATEMENT TO THE MEMBERS OF THE CORPORATION OF THE MARINE BIOLOGICAL LABORATORY

The accompanying statement includes resolutions of the Executive Committee of the Carnegie Institution, which are intended only for members of the Corporation of the Marine Biological Laboratory. The text of these should not be allowed to become public property.

At a meeting of the Trustees held at Woods Holl, July 19, 1902, the undersigned were appointed members of a committee to report to the Corporation the plans for reorganization that have been under consideration during the last year. These plans have finally been brought to a successful issue by the unanimous adoption of an offer of affiliation with the Carnegie Institution, which insures large and permanent financial support to the Laboratory and guarantees its future development. In order to place the matter fully before the Corporation, this Committee respectfully offers the following statement of the general course of the negotiations.

For several years the financial needs of the Laboratory have been growing without any corresponding increase of income until the conditions became alarming. The Trustees had frequently been told, by those to whom appeals for support were made, that the defects of our business organization were deterrent to those who might otherwise contribute to its material support. This condition was brought to a crisis by an offer received by the Trustees before the last annual meeting of the Corporation, under which generous financial support was guaranteed provided a suitable business organization could be effected. It was to attain this end that the Trustees asked at the last annual meting of the Corporation that the power of modifying the by-laws be entrusted to them. This power was given by a modification of the by-laws adopted at the annual meeting in August, 1901.

The plan under consideration at that time involved the transfer of the property of the Laboratory to a small section of the present board, composed of business men who were to assume full financial control and management, while the scientific members of the board were to continue as an advisory scientific council, with general supervision of the work of the Laboratory. It was thus hoped to secure an efficient financial administration as well as large financial support, without sacrificing the independence of the Laboratory or the co-operative principle which has been so potent a factor in its success in the past.

This plan was unanimously adopted at the winter meeting of the Trustees, held at Chicago, Jan. 2, 1902, during the session of the Society of American Naturalists, but before ratification of this action, the announcement of the Carnegie Institution suggested the possibility that the great resources of this endowment might be made available for the support of the Laboratory. Preliminary inquiries made by members of our board met with encouraging response, and a formal application for aid was made to the Carnegie Institution in a letter to President Gilman, and by him referred to the Executive Committee of the Carnegie Institution, which appointed Dr. Billings as a committee of one to confer with a committee appointed on our side consisting of Messrs. Osborn, Whitman, Wilson, and Brooks. As a result of this conference Dr. Billings signified his willingness to make a favorable report on our application and to recommend that the Carnegie Institution should place the Laboratory on a permanent

basis, purchase the necessary land, erect and equip a new laboratory, and make suitable provision for its maintenance. He expressed the opinion, however, that, if this maintenance were to be of a permanent character, the Carnegie Institution should be placed in full financial control of the property of the Laboratory.

As a result of this conference, a meeting of the Board of Trustees of the Marine Biological Laboratory was called, which met in New York, March 22, 1902; at this meeting the following resolutions were passed:—

1. "*Resolved:* That the Trustees approve the incorporation of the Marine Biological Laboratory by the Carnegie Institution on the lines indicated in the letter of Dr. Billings, and that the chair appoint a committee of six, including himself, to confer with the Executive Committee of the Carnegie Institution and make such arrangements as are deemed advisable and necessary regarding the legal incorporation, the personnel of the new board, and the manner of conducting the Laboratory in the future. This committee to report to the present board for final action as soon as practicable."

2. "*Resolved:* That it is the sense of this meeting that it is desirable that the incorporation be so conducted as to leave open and invite the co-operation of the present friends and supporters of the Laboratory and others."

The committee appointed under the first of these resolutions consisted of Messrs. Wilson, Crane, Herter, Hoar, Nunn and Whitman.

After Doctor Billings' report and the presentation of these resolutions to the Executive Committee of the Carnegie Institution, the following resolutions were passed by that committee at a meeting held in New York, March 25, 1902:—

1. "*Resolved:* That the acquirement of the Woods Holl Laboratory by the Carnegie Institution, with the understanding that the Trustees of the Laboratory are willing to turn over its plant to the Institution, provided the latter will undertake the maintenance and support of the Laboratory, is approved by the Executive Committee, and that such action will be recommended to the Board of Trustees at its meeting in November next as part of the report on the general scope and plan of the work of the Institution."

2. "*Resolved:* That a special committee consisting of John S. Billings, A. S. Hewitt and S. Weir Mitchell be appointed for the consideration of all matters connected with plans for research and instruction in the Department of Marine Zoölogy [Biology], to which committee all communications relating to this department of scientific work shall be referred."

3. "*Resolved:* That this committee is requested to confer with the Trustees of the Woods Holl Laboratory for the preparation of a plan in detail for the organization of the Laboratory and its work, said plan to be reported to the Executive Committee."

4. "*Resolved:* That if satisfactory evidence is furnished to the Executive Committee that the Trustees of the Woods Holl Laboratory have full power to transfer the property of the Laboratory to the Carnegie Institution, and have agreed to do so, the sum of $4,000 payable on or after August 1, 1902, be and the same is hereby granted from the funds of the Carnegie Institution to the Trustees of the Woods Holl Laboratory as a contribution towards the expenses of the Laboratory for the coming summer."

Two joint meetings of the conference committees, representing the Marine Biological Laboratory and the Executive Committee of the Carnegie Institution, were held in New York on April 12 and May 31, 1902. Prior to the first of these meetings a preliminary sketch of by-laws had been drawn up as a basis of discussion, and at the first of these conferences the Carnegie representatives were asked whether they would accept a joint board of trustees equally representing the Carnegie Institution and the existing Board of Trustees of the Marine Biological Laboratory. This proposition was not accepted by Messrs. Billings and Hewitt, who stated in substance that it was not the policy of the Carnegie Institution to enter into organic alliance with existing institutions in such a manner as to involve divided control; that the institution might from time to time make special grants to the Marine Biological Laboratory as a separate and independent institution, as it might to other institutions or individuals; but that permanent and continuous support involving the purchase of land, erection and equipment of buildings, and regular contribution of funds for running expenses could only be promised to the Laboratory on condition of a definite and complete transfer of the property to the Institution, so that it might assume full financial control and responsibility. They stated very positively at that time, and subsequently, that it was the wish and intention of the Carnegie Institution, upon assuming control of the Laboratory, to give the managers the fullest possible scientific independence and freedom, and not to interfere with either the general scientific policy or the details of the management.

Accepting these as fundamental conditions, the members of the committee subsequently gave their careful consideration to the proposed by-laws, and finally again met Messrs. Billings and Hewitt at a meeting held in New York on May 31, 1902.

At this meeting the by-laws were amended to substantially the form finally adopted by the unanimous vote of the Trustees at a meeting held in Woods Holl, July 19, 1902.

It has been the aim of the Trustees to retain with as little change as possible under the Carnegie reorganization those features of the present organization and policy of the Laboratory that seem to them to have been potent factors in its effectiveness and success heretofore. Foremost among these, we believe, has been its representative and co-operative character, and its independence of local control. The Trustees believe that the maintenance of this character under the Carnegie reorganization is guaranteed in the by-laws by paragraph 1, which provides for a representative scientific Board of Managers (to be constituted at the start by the present Board of Trustees); and by paragraphs 6 and 11, which give this Board the power to manage the Laboratory, to appoint and define the duties of the Director and other officers, and, in general, to take charge of the scientific work, subject only to the limits of the appropriations made by the Carnegie Institution and of income from other sources. Attention is called to the very broad scope of paragraph 11, which is considered of especial importance as giving the Board of Managers full power to make their own "rules and regulations" regarding all matters of scientific management, including the appointment of the Director and other officers, the definition of their duties and powers, and all other matters not specifically provided for in the by-laws. This gives to the Board substantially the same powers as those of the existing Board of Trustees, and renders unnecessary the insertion of various special by-laws which may be left to the "rules and regulations" of the Board.

By the change in the by-laws of August, 1901, the Trustees have full power to effect all of the reorganization except the transfer of the property to the Carnegie Institution, which can only be effected by vote of the Corporation. The Trustees unanimously recommend to the Corporation that this transfer be effected, and will ask for the necessary vote by the members of the Corporation at the annual meeting to be held in Woods Holl, Tuesday, August 12, 1902. At this meeting the text of the new by-laws, which are in all essential respects similar to those under which the Laboratory is at present working, will be laid before the Corporation and may be consulted by any member.

[*Signed*]
FRANK R. LILLIE (*Chairman*)
C. M. CLAPP
E. G. GARDINER
C. O. WHITMAN
E. B. WILSON.

Wood's Holl, Mass.,
July 28, 1902.

III, A, 13

THE IMPENDING CRISIS IN THE HISTORY OF THE MARINE BIOLOGICAL LABORATORY.[1]

BY C. O. WHITMAN.

The action of the corporation of the Marine Biological Laboratory, at its recent meeting, August 12, leaves the fate of the laboratory to be decided by the trustees of the Carnegie Institution. It was not a welcome step to surrender the laboratory, but the financial situation seemed to offer no other solution. Some felt very strongly that further deliberation was much needed, but there was danger that delay would prejudice our case with the Carnegie trustees. Compulsory as were the circumstances, it is certain that the corporation and the trustees would have said no to the proposition to surrender, had they felt that our work and plans for the development of a biological center of a national character would thereby be hampered or curtailed. As the matter now stands, it only remains for the trustees of the Carnegie Institution to decide whether they will consummate the steps already taken towards acquiring the laboratory and making it a 'department' of the institution.

In spite of the assurances to the contrary which we have received through one or two of our trustees, I think we may already see that the organization of the Carnegie Institution will necessarily limit our freedom of action and perhaps deprive us of the most essential thing in our independence, namely, *the power to decide upon the nature and scope of our work*. Had such a danger been seen even as a possibility, it is doubtful if the corporation could have been persuaded to transfer the ownership of the laboratory; and had it been seen as a probability, it is certain, I believe, that the vote to transfer would never have passed.

The vote was essentially a vote of confidence in our hoped-for supporters. Only our part of the situation was entirely definite. What the Carnegie Institution would

[1] Reprinted from *Science*, N.S., **16**, No. 405 (October 3, 1902), 529–33.

develop as an organization was too largely a matter of conjecture to permit of clear vision. Some points had come out in personal conferences with members of the Carnegie executive committee, but these had not been definitely enough formulated to bring before the corporation. The visible portion of the situation was a debt of about $10,000, doubled by the purchase of land just completed, and an offer of money-relief, contingent on a complete surrender of property rights. It was known, of course, that the transfer of property would make the laboratory a "department" or "branch" of the Carnegie Institution, centered at Washington. It was not realized that becoming a "department" might in some fundamental respects endanger our control of the future development of the laboratory. In fact, we were told by some of those who had formulated the scheme of amalgamation that we should lose nothing essential to our independence, while we should gain a permanent support that was "almost beyond the dream of avarice"! We were told that if we delayed decision, it would look like lack of confidence, and that we might thus lose not only the support but also the good-will of the Carnegie trustees. Unripe as the situation was, and unprepared as the corporation was for the final action, circumstances were so compelling that we said no to our doubts and preferences and yes to the Carnegie offer.

Although we have neither asked nor received any guarantees that our freedom of development shall remain unimpaired, it is nevertheless certain that our 'yes' implied trust in the fulfilment of this condition. Few of us, perhaps, had reflected upon the situation sufficiently to realize that barriers might intervene between trust and fulfilment which could not have been anticipated on either side at first. An organization once inaugurated on a permanent endowment is a thing of power. It holds even its authors to a logical development. It becomes law to them and to all who have accepted its authority. The organization of the Carnegie Institution is still *in ovo* in many respects, but as it gradually unfolds it will create classifications and standards to which departments and future developments will have to conform. It is conceivable, even certain I think, that the nature and scope of our plans for development have not been fully grasped by the Carnegie trustees. Can we expect them to shape their organization in such a way as to leave us masters of our own development? If they do not do this, what becomes of the 'trust' and the 'fulfilment'?

We may have the fullest trust in the men behind an organization, and the deepest distrust of the influence which the organization will have on the development of our plans. The organization which they create will define their policy and attitude towards all departments. It will control them and us, and decide for us all what departments shall receive support, and where they shall be located. It requires no prophetic vision to predict that the part will not assimilate the whole.

Hitherto we have been independent. That means that we have been a whole, with the center of interest and the center of authority at Wood's Holl. No one could dispute with us our right to say what departments of biology should be represented here. We could follow our own ideals to the extent of ability and means. All directions of development were open to us. All avenues of support were ours to cultivate and make tributary to an unfettered enterprise. It was on this independence as a foundation that our interests in the present and faith in the future rested. It was the same foundation that sustained the co-operative spirit and the national character of the laboratory. It was our ground of appeal in all emergencies, and the basis of every claim to a wide financial support, the first realizations of which were already at our doors.

The proposition to merge the laboratory in another institution after a fifteen years' struggle for independent existence, at a moment when a strong financial support was on the point of realization, could hardly be expected to satisfy those who had led the struggle, or those who had given the cause unrequited aid and never-failing sympathy. I venture to say that the personal sacrifices already made in the development of the laboratory, the work it has done in research and instruction, the example it has given of the efficacy of co-operation in science, the ideals it has upheld, the national character of its organization, the promising increase of its financial support, all entitle it to hold its independence above any price.

Our attitude towards the proposition has been determined mainly by the desire to secure an immediate and permanent support. While we all agree in the desire, we certainly do not all agree that we can surrender the independence of the laboratory with either honor or safety.

It is an undeniable fact that we should all much prefer to have the needed support come to the laboratory rather than see the laboratory go to the support. Why should the support, if it be deserved, not be given to the laboratory, rather than the laboratory to it? Would not the first alternative accord with the declared policy of the Carnegie Institution better than the second? and would it not also better accord with the judgment and expectations of men of science?

It is due to the trustees of the Carnegie Institution to say that the proposition to acquire the laboratory as a condition to supporting it did not originate with them. This is the humiliating side of the situation in which we now find ourselves. They were told that the laboratory was in dire financial distress, that some local western institution was machinating to get possession; in short, that there was an emergency requiring immediate action to save the institution. They were asked on what terms they would consent to own and support it.

When at the conference with the Carnegie Committee the question was asked if they would be willing to support the laboratory without owning it, the reply was that they should have *preferred to give support without taking the whole responsibility of ownership.* It was the 'emergency' that induced them to make the offer of support contingent on our surrender of the ownership to them. It was made clear to us, however, that support without ownership might be considerably less than support with ownership, and that it would have to take the form of a grant to run for a limited time, which might or might not be renewed.

The practical question for us then is: Is our independence plus the possible support by grant from the Carnegie Institution plus the possible outside support, of greater moment to us than a permanent support minus independence and minus outside support? The four elements when taken in the combinations given should be ranked, I believe, in the following order: (1) Independence, (2) outside support, (3) grants, (4) contingent permanent support. Holding independence first, contingent permanent support, which excludes it, must be placed at the foot of the list, as the last resort. The other two elements stand for unknown sums that may be realized on the basis of independence. Outside support, including (1) a definite annual gift pledged for a series of years, (2) co-operative subscriptions from universities, colleges and societies, and (3) individual donations, may be estimated at from $10,000 to $15,000 a year, with prospect of indefinite increase from year to year.

In deciding a question that involves the whole future of the laboratory, it is but the

part of wisdom to take a long look ahead. A source of unlimited support, that has an ever-improving prospect for increase, must count for more in the long run than the largest sum to be expected from the Carnegie Institution. Starting with $10,000, which was the annual donation pledged for five years at the beginning of this year, it is next to certain that this sum could have been increased to $20,000 within three to five years. That sum once reached, would not be henceforth a non-growing quantity, shutting out possibilities of endowment and further donations, but rather one with ever-improving chances of enlargement.

This unlimited prospective growth of our present support is as much a certainty as that we shall deserve it. With this growth the co-operative policy hitherto cultivated will remain the best guarantee of the national character of the laboratory. We cannot afford to relinquish the possibilities before us for the sake of an immediate relief which is far from being equal to a permanent laboratory, and which, if accepted with all the conditions implied, will prove only a temporary relief, barring the way for greater assistance.

What is $20,000 a year for an all-the-year station, when we are now spending at least $13,000 for a summer's work? If Dr. Dohrn requires not less than $40,000 to $50,000 to meet the annual expenses of the Naples Station, with an average of not over twenty-five investigators, the same plant here would cost about double that sum. At Naples they can charge $500 a year for a single investigator's table. Here there are too many free laboratories to admit of any price on our tables. Moreover, we have to provide for three times as many investigators as they have at Naples, at least for the summer months.

The glowing anticipations of a permanent laboratory rivaling anything in the world, with which we have been regaled, rise far above the $20,000 a year. For the present, at any rate, they are but *châteaux en Espagne*, calculated only to console a premature optimism, which can forsake the larger weal in the distance for the nearer allurement that fetters and mortgages the whole future.

Much as we need now, we have larger needs ahead, for which all avenues of support should be kept permanently open. The support that is given to support, that has the potentials of unlimited growth, that asks not to possess, but only to promote, is something incomparably more precious than any support to which is prefixed the *sine qua non* of absolute possession and authority. It is more precious, not only for all the qualities of disinterested beneficence, but also for the reason that it is essentially co-operative in character, and is thus in harmony with the policy of the laboratory.

Co-operation has been the law and the gospel of our whole scheme of organization. It is the one thing that has given the laboratory unique distinction among marine stations. The prime condition of honest and effective co-operation is an independent organization, representing fairly all interests concerned. Independence has therefore been no meaningless word with us, and hitherto no embarrassments of poverty have tempted us to purchase relief through annexation to another institution.

It is difficult to see how independence can be exchanged for money and co-operation still remain unimpaired. Co-operative support and independence will certainly go, as they have come, together. Can we lose co-operative support and yet keep the co-operative spirit? We can hardly expect to perform the miracle of separating body and spirit.

Co-operative support is a means to an end. It presupposes need, and its realiza-

tion is possible only under inviting conditions and persistent cultivation. The need alone cannot call it into activity; independence alone cannot bring it forth; and cultivation has no point without the need, and no hope of success under conditions that abridge either the motives or the purposes in view.

The 'atmosphere' or 'spirit' that prevails in the laboratory emanates chiefly from the interaction of sympathies enlisted in a common cause. Cause, responsibility, free initiative, free development, untrammeled policy, all go with independence. The surrender of the ownership of the laboratory reduces it at once to the level of an annex, subordinates its individuality, strips it of final authority, robs it of power to control its own destiny, and subjects its present owners permanently to the condition of petitioners.

If the situation has been fairly stated in its essentials; if the history of the laboratory points the way to its future welfare; if support is deserved at no sacrifice of independence; if to aid without taking possession would accord with the policy of the Carnegie Institution as well as with the preference of the laboratory people; if this would better meet the expectations of men of science generally, then the trust we have placed in the Carnegie trustees will surely find its best justification in the suggested modification of their proposition to us.

C. O. WHITMAN.

III, A, 14

Resolutions passed by the Executive Committee of the Carnegie Institution, October 3 and 4, 1902, and covering letter from Dr. J. S. Billings of the Carnegie Institution.

October 4, 1902.

Prof. E. B. Wilson, Acting Secretary,
Marine Biological Laboratory, Wood's Hole, Mass.

DEAR SIR:—

I enclose herewith a copy of resolutions, relating to the Wood's Hole Laboratory, passed by the Executive Committee of the Carnegie Institution at its recent meeting in New York City, and respectfully request that they may be brought before the Trustees of the Marine Biological Laboratory as soon as possible.

In transmitting these resolutions I desire that it should be clearly understood by the Trustees that the Executive Committee highly appreciates the interest and value of the work which has been done at the Laboratory, and also the great service which has been rendered by Dr. Whitman in this work, not only by his own investigations but by the powerful stimulus which he has given to other investigators. Dr. Whitman's paper on "The impending crisis in the history of the Marine Biological Laboratory," published in "Science," October 3rd, 1902, has been carefully considered, a copy of the Ms. having been sent to me about three weeks ago, and his desire to retain complete independence is fully understood.

His plan for the future development of the Laboratory, as set forth in the report of the Board of Trustees, is not approved by the Executive Committee at present, in part because its approval would commit the Institution to an amount of expenditure which it is not prepared to undertake, in part because it is believed that the majority

of the investigators of biological problems in this country would, at present, make more use of an institution managed on the lines of the Naples Laboratory.

If there is any prospect that the plan of Dr. Whitman can be carried out with the help of a grant of ten thousand dollars a year from the Carnegie Institution, I feel confident that the Executive Committee will recommend such grant upon some such terms as are indicated in their resolution. Moreover, if the Board of Trustees think this plan preferable, it can be tried for a year, and if at the end of that time the Trustees are dissatisfied with the results, they can come back to the proposition of merging the Laboratory in the Carnegie Institution.

The Executive Committee has no desire in the matter except to see that the funds of the Institution shall be so used as to best promote the increase of knowledge and the increase of facilities in this country for the work of competent original investigators, and the more that any other independent institution is willing to do in this direction the better it will be pleased.

It has no desire to assume responsibilities in any particular line of work, but when it considers it to be its duty to recommend to the Carnegie Institution to take up the responsibility of maintaining some special institution, it will also recommend that the Institution shall have complete power.

The generous act of confidence in the Carnegie Institution by the Trustees and Incorporators of the Marine Biological Laboratory at Wood's Hole in offering to turn over their property without definite conditions, has been highly appreciated by the Executive Committee and I hope it will be clearly understood by the Trustees that this action of referring the matter back to them for further consideration, is intended only to give them a full opportunity for considering the whole question anew, if they so desire, after understanding the action which the Executive Committee proposes to take in its recommendations to its own Board of Trustees.

Hoping to receive an answer to this on or before October 25th, I remain,

Very truly yours,

JOHN S. BILLINGS.

enc.

III, A, 14

Extract from the minutes of proceedings at a meeting of the Executive Committee of the Carnegie Institution held in New York City, October 24, 1902.

The Executive Committee, having considered the report of the Sub-Committee upon the Marine Biological Laboratory at Woods Hole, with the accompanying Documents, more especially the Minutes of the meeting of the Board of Trustees of the Laboratory on July 19, 1902, the extracts from the meeting of the Corporation of the Laboratory on August 12 and the report of the Board of Trustees on scope and plan with accompanying estimates, etc., are of the opinion that before definitely formulating their report on this subject to the Carnegie Institution, it is advisable that the Trustees of the Laboratory shall be informed of the general principles which will govern the Executive Committee in its recommendations on this subject and shall be requested to furnish some additional information.

The general principles referred to above are as follows:—

I. If the Laboratory becomes the property of the Carnegie Institution, it is to be distinctly understood that in case of difference of opinion as to expenditures to be made or liable to be incurred or as to the policy to be pursued in the conduct of the Laboratory, the decision of the Carnegie Institution, after proper hearing of the views of the Trustees of the Laboratory, shall be final and conclusive.

II. It will be recommended that the Laboratory be used for research and not for teaching and that no instruction shall be given there, except such as may be furnished by investigators to their assistants. In this respect the Laboratory shall be conducted, for the present, on the lines of the Naples Laboratory and no salaries will be allowed for instructors or lecturers. The object of the Laboratory should be to provide competent investigators with facilities for making researches, each one selecting his own problem and working it out in his own way.

III. The general scheme proposed by the Board of Trustees of making the Laboratory an institution for the investigation of problems of evolution, heredity, etc., including a biological farm, under the supervision of a scientific director, is not approved by the Committee.

IV. Some of the changes recommended by the Board of Trustees of the Laboratory in the proposed by-laws are not approved. The first, second, third, seventh and eighth of these by-laws should remain as originally proposed, with slight verbal amendments. The Board of Managers should represent the biological teachers and investigators connected with the institutions for higher education in this country, and the Carnegie Institution will take care that this representation is secured.

V. Additional information is desired as to certain details for the year 1903. It does not appear to the Executive Committee expedient to commence the erection of buildings with a library building of the size, character and cost of that proposed. The Committee will not recommend more than $80,000 for land, buildings, wharf and vessel, the expenditure to be spread over two years, nor will it recommend more than $10,000 a year for maintenance. It does not seem desirable at present that the Woods Hole Laboratory should be kept open throughout the year, and if a vessel for making collections is to be provided, it should be one that can be sent to and used in tropical waters, if it seems desirable to do so.

VI. If, after considering these statements, the Board of Trustees is of the opinion that it would prefer to retain the independence of the Laboratory, as urged by the present Director, and not turn over its property to the Carnegie Institution, the Executive Committee is prepared to consider a proposition for granting aid to the laboratory to the amount of ten thousand dollars a year for the next (3?) years, on condition that twenty research tables be placed at the disposal of the Carnegie Institution, the occupant of each table to be furnished with supplies and material substantially as is done by the Naples Laboratory.

The Special Committee on Marine Biology, of which Dr. J. S. Billings is chairman, is requested to inform the Board of Trustees of the Laboratory of these conclusions and to report the result with its recommendations to the Executive Committee by October 25, 1902.

October 4, 1902.

APPENDIX TO CHAPTER IV

IV, A, 1

Deed of trust for endowment funds of the Marine Biological Laboratory.

FRIENDSHIP FUND, INC., AND CENTRAL UNION TRUST COMPANY OF NEW YORK.

AGREEMENT.

Dated New York, January 22, 1924.

Agreement made the 22d day of January, 1924, between FRIENDSHIP FUND, INC., a corporation organized and existing under the Membership Corporation Law of the State of New York, and having its principal office at 70 Fifth Avenue, in the City, County and State of New York (hereinafter known as the "Grantor"), and CENTRAL UNION TRUST COMPANY OF NEW YORK, a corporation organized and existing under the Laws of the State of New York, (hereinafter sometimes called the "Trustee"), having its principal office at 80 Broadway, in the City, County and State of New York:

WITNESSETH:

That in consideration of the premises and of the agreements hereinafter contained, the Grantor does hereby assign, transfer and set over unto the said Central Union Trust Company of New York, as Trustee, and to its successor and successors in trust, securities of the par value of Four hundred and five thousand Dollars ($405,000), and of the approximate market value as of December 31, 1923, of Three hundred ninety four thousand and twenty-one Dollars ($394,021), which said securities are listed upon a schedule hereto annexed and marked list of securities, IN TRUST NEVERTHELESS, upon the uses and trusts following, that is to say:

1. To hold, manage, invest and reinvest the same, to collect the income, interests, issues and profits therefrom and after paying all proper and necessary expenses including compensation of the Trustee to pay over the net income as collected in monthly instalments to the Marine Biological Laboratory, (sometimes hereinafter called the "Beneficiary"), a corporation organized and existing under the Laws of the State of Massachusetts, and having at the present time its laboratory at Woods Hole, in the Town of Falmouth, State of Massachusetts. All such payments shall be made to the Treasurer of the Beneficiary or such other officer or person on its behalf, as the said Beneficiary may from time to time designate.

2. The investment and reinvestment of the fund shall be made by the Trustee in consultation with the Treasurer of the Beneficiary. The Trustee shall be at liberty to retain any of the securities received by it hereunder, and it may in its discretion sell all or any part of the same. The Trustee may invest and from time to time reinvest the proceeds of sale of any of the trust property or any cash held in trust, in such stocks, securities or other property as may seem to the Trustee advisable and the Trustee shall not be restricted in making investments or reinvestments of trust funds

to such stocks, securities or property as may be permissible investments for trustees by any present or future laws of the State of New York or any other state.

(As amended July 21, 1939)

3. A Committee of Review is hereby constituted. Such Committee to consist of nine (9) members in all and to include an official representative of each of the following: The National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science, and six (6) professors in the field of biology named respectively by a majority vote of the professors of the departments in the field of biology of the following universities, to wit: Harvard University, Columbia University, University of Chicago, Princeton University, Yale University, and University of Pennsylvania.

Membership on the Board of Trustees of the Marine Biological Laboratory or other connection with the Beneficiary shall not disqualify a person from acting upon said Committee of Review.

In the event that any of the nine institutions mentioned shall be unwilling or unable to appoint a representative, such vacancy shall be filled by an appointment made in the same manner as above provided by the departments in the field of biology of the following universities, in order named: University of Michigan, Johns Hopkins University and Leland Stanford University, and in the event of any of these universities being unwilling or unable to fill such vacancy, or of there being further vacancies in said Committee, then such vacancy or vacancies may be filled by appointment of professors in the field of biology named by the majority vote of the members of the Committee of Review already appointed.

It shall be the duty of the Trustee to call once every ten years (10) upon this Committee of Review, to make a study of the work at the Marine Biological Laboratory, and if two-thirds of the entire Committee shall agree that the Marine Biological Laboratory is not performing valuable services in biological research and shall file a written memorandum with the Trustee stating such conclusion and their reasons therefor, a copy of which memorandum shall be sent to the Beneficiary forthwith, and if after a period of five years two-thirds of the entire Committee of Review as then constituted shall again report in writing to the Trustee that the Marine Biological Laboratory is not performing valuable services in biological research, then the fund both principal and interest may be used for such other purposes within the general field of biological research as shall be indicated by this Committee of Review, on an affirmative vote of not less than two-thirds of the entire membership of said Committee.

4. The said Committee of Review may by two-thirds vote of its entire membership, remove the Trustee, and upon the removal, resignation or cessation of the Trustee to function, may appoint a successor trustee, and in default of such appointment the duty of appointing a successor trustee shall devolve upon the Supreme Court of the State of New York. The Beneficiary may call the Committee together for such action.

5. The Trustee shall send semi-annually to the Treasurer of the Beneficiary, a full statement of the investments then held by the Trustee, and of the receipts and expenditures in both income and principal accounts since the last semi-annual statement, and at the request of the Treasurer, the Trustee shall cause an audit to be made of the books and accounts of the Trustees with respect to this trust, by certified accountants of recognized standing, and a reasonable compensation for such audit if

requested by the Treasurer, shall be paid by the Trustee and charged against the income as an expense of the administration of the trust.

6. The Trustee is authorized and empowered as the Trustee of an express trust to institute, conduct, defend, intervene in and compromise or terminate any and all suits, actions or proceedings at law or in equity or otherwise whenever the Trustee shall consider it necessary or proper so to do for the collection of the principal or interest on any of the securities held by it hereunder, or of the rights or interests of itself as Trustee, or of the Beneficiary hereunder with respect to the trust property. The Trustee shall have full discretionary power to allocate as between principal and income any expense with respect to the foregoing, and shall have full discretionary power to sell such portion of the trust as may be necessary to pay or recoup itself for the payments of such amount of such expense as shall have been allocated to the principal or the trust estate.

7. The Trustee is authorized and empowered as the Trustee of an express trust, to exercise all rights and powers pertaining to any securities held by it; and as the holder of such securities the Trustee may in its discretion join in any reorganization, merger, consolidation or dissolution of any corporation whose securities it holds, whenever such action may be deemed by the Trustee in its discretion necessary or proper in the interests of the trusts; and the Trustee may accept in exchange for such securities any new securities issued in exchange therefor upon any such reorganization, merger, consolidation or dissolution.

The provisions of this article are not intended as a limitation upon the powers accruing to the Trustee hereunder as a Trustee of an express trust.

8. The Trustee shall not be required to retain or set aside any portion of the income derived from securities for the purpose of creating a sinking fund to amortize the premium upon any securities purchased or taken over above par and conversely, if securities shall be purchased or acquired at a discount, and there shall subsequently be collected or realized thereon on sale or collection an amount in excess of the original investment therein, the amount of such excess shall be treated for all purposes as principal and not income.

9. The Trustee shall be entitled to reasonable compensation for its services rendered hereunder, and as long as the Central Union Trust Company of New York shall be Trustee it is agreed that the amount of such compensation in full for all its services herein shall be the sum of Three hundred and fifty Dollars ($350), per annum. Payment on account of such amount to be deducted and withheld from time to time in the discretion of the Trustee as income is collected or received.

10. The Grantor reserves unto itself full power to enforce the provisions of this Deed or Trust, and, for that purpose, to institute, conduct, defend, intervene in, compromise or terminate, either by itself or jointly with the Beneficiary, any and all suits, actions or proceedings at law or in equity or otherwise against the Trustee or its successors under this Deed of Trust, provided that the Grantor, when acting under the provisions of this article, shall be deemed to be acting on behalf of the Beneficiary; provided further, that nothing in this article shall be deemed to deprive the Beneficiary named hercin, or the person or persons to whom the net income and revenue arising under this Trust are payable, of the right to enforce in behalf of the Beneficiary the provisions of this Deed of Trust, except in cases in which the Grantor shall already have taken action to enforce such provisions on behalf of the Beneficiary.

11. Except in so far as is otherwise provided by the provisions of this Deed of Trust, the Trustee named shall be deemed to possess and enjoy the powers and rights recognized under the law of the State of New York as belonging to the Trustee of an express trust.

12. This deed may be amended by agreement in writing between the Friendship Fund, the Trustee for the time being and the Beneficiary, or if the Friendship Fund has ceased to exist by the agreement of the Trustee and the Beneficiary, with the approval of two-thirds of the entire membership of the Committee of Review.

13. The Trustee is authorized to receive and hold under this Deed additional securities, cash and property, pursuant to the terms and conditions hereof. Such additional gifts may be received from any person, corporation or association. The compensation of the Trustee on such additions shall be proportionate to the compensation herein provided.

In witness whereof, the Friendship Fund, Inc., has caused these presents to be executed by its duly authorized officers, and the Central Union Trust Company of New York, in token of its acceptance of the trusts herein contained, has caused these presents to be executed by its duly authorized officers, as of the 22d day of January, 1924.

Friendship Fund, Inc.

[*Signed*] Lawrason Riggs, Jr.
Secretary

(*Signed by*] Charles R. Crane,
President

Lawrason Riggs, Jr.
Treasurer

Central Union Trust Company of New York,

[*Attest:*]
H. L. Williams,
Asst. Secretary

[*Signed by*) B. A. Morton,
Vice-President.

[*Seal*]

Whereas, Friendship Fund, Inc., did on the 22d day of January, 1924, make a Deed of Trust to the Central Union Trust Company of New York, as Trustee, of certain securities for the benefit of Marine Biological Laboratory, as is more fully set forth in said Deed; and

Whereas, paragraph 13 of said Deed provided as follows:

13. The Trustee is hereby authorized to receive and hold under this Deed additional securities, cash and property pursuant to the terms and conditions hereof. Such additional gifts may be received from any person, corporation or association. The compensation of the Trustee on such additions shall be proportionate to the compensation herein provided.

Know all men by these presents:

That in consideration of the premises and in consideration of the payment to it as Trustee, on January 25th, 1924, of $400,000 from Mr. John D. Rockefeller, Jr., by check to the order of Marine Biological Laboratory, endorsed to Central Union Trust Company of New York, as Trustee, under said Deed aforementioned, and in consideration of the payment to it as Trustee, on January 26th, 1924, of $100,000 from Carnegie Corporation of New York, by check to the order of Marine Biological Laboratory, endorsed to the Central Union Trust Company of New York, as Trustee, receipt whereof is hereby acknowledged, the Central Union Trust Company of

New York agrees with Friendship Fund, Inc., and with the other donors above mentioned, to hold said additional gifts under all of the terms and conditions of said Deed of Trust between Friendship Fund, Inc., and Central Union Trust Company of New York, dated January 22, 1924.

In witness whereof, Central Union Trust Company of New York, has caused these presents to be executed by its duly authorized officers and its corporate seal to be hereunto affixed, as of the 26th day of January, 1924.

Central Union Trust Company of New York,
By B. A. Morton.
Vice-President. [*Seal*]

State of New York
County of New York } ss.:

On this 4th day of February, in the year One thousand nine hundred and twenty-four, before me, the undersigned, personally came B. A. Morton, to me known, who, being by me duly sworn, did depose and say that he resides in New York, N.Y.; that he is a Vice President of Central Union Trust Company of New York, the corporation described in and which executed the foregoing instrument; and that he signed his name thereto by order of the Board of Trustees of said corporation.

Harold A. Cunningham. [*Seal*]
Notary Public.

IV, A, 2

THE REPORT OF THE TREASURER

To the Trustees of the Marine Biological Laboratory:

Gentlemen:

Herewith is my report as Treasurer of the Marine Biological Laboratory for the year 1940.

The accounts have been audited by Messrs. Seamans, Stetson and Tuttle, certified public accountants. A copy of their report is on file at the Laboratory and is open to inspection by members of the Corporation.

At the end of the year 1940, the book value of the Endowment Fund in the hands of the Central Hanover Bank and Trust Company, as Trustee, was

General Fund, Securities (market $807,499.95)	$856,629.50
Interest in Real Estate	24,921.89
Cash	30,648.97
	$912,200.36
Library Fund, Securities (market $150,077.06)	$164,294.79
Real Estate	20,000.00
Cash	10,862.62
	$195,157.41

The income collected from these funds during the year was:

General Endowment	$ 35,674.49
Library	8,463.30
	$ 44,137.79

The income in arrears on these funds at the end of the year was:

Arrears General Fund	$ 12,253.69
Arrears Library Funds	4,325.00
	$ 16,578.69
Arrears at the end of 1939	$ 15,322.81
A falling behind of	$ 1,255.88

General Biological Supply House, Inc.: The dividends from the General Biological Supply House, Inc. totalled $18,542.00, an increase of $3,556 over 1939.

Bar Neck Property: The rental from the Bar Neck property which is based on the net profit of the garage was $5,097.64, an improvement of about $1,500 over the prior year, during which the absence of the drawbridge adversely affected the business of the garage.

In addition, the notes given for the acquisition of the Bar Neck property are now paid off so that the entire income from this property can now be used for current expenses of the Laboratory.

Retirement Fund: A total of $3,710 was paid in pensions and $923.20 advanced from current funds in prior years was repaid. This fund at the end of the year consisted of:

Participations in mortages	$ 8,154.39
Interest in Real Estate	2,301.88
Cash	5,048.06
	$ 15,504.33

Plant Assets: The land (exclusive of Gansett and Devil's Lane Tracts), the buildings, equipment and library represent an investment of $1,867,005.60
Less reserve for depreciation 564,225.03
or a net of $1,302,780.57

Income and Expenses: Income exceeded expenses (including depreciation of $25,648.22) by $8,035.14.

There was expended from current funds for plant account a net of $16,702.27 and in payment of note indebtedness $3,500, and $2,500 was transferred to the Reserve Fund.

The total damage caused by the hurricane on September 21, 1938, finally liquidated during 1940 was $30,152.47
of which 20,000.00
was met by the grant of the Carnegie Corporation (1939) and the balance of $10,152.47 was paid from current funds or charged off.

At the end of the year the Laboratory had no indebtedness on notes or mortgages. It owed on accounts payable $3,689.51, against which it had accounts receivable of $11,667.91 and cash in its general bank accounts of $13,359.26.

The Rockefeller Foundation made a grant of $110,400 for an addition to the library. During 1940, there was received $64,776.62 on this grant, of which $39,851.12 was expended in the year.

Following is the balance sheet, the condensed statement of income and outgo and the surplus account all as set out by the auditors.

EXHIBIT A

Marine Biological Laboratory Balance Sheet

December 31, 1940

Assets

Endowment Assets and Equities:			
Securities and Cash in Hand of Central Hanover Bank and Trust Company, New York, Trustees —Schedules I-a and I-b		$1,107,357.77	
Securities and Cash—Minor Funds—Schedule II		9,194.41	$1,116,552.18
Plant Assets:			
Land—Schedule IV	$ 111,425.38		
Buildings—Schedule IV	1,277,685.06		
Equipment—Schedule IV	179,181.15		
Library—Schedule IV	298,714.01		
	$1,867,005.60		
Less Reserve for Depreciation	564,225.03	1,302,780.57	
Cash in Building Fund		24,925.50	
Cash in Reserve Fund		2,524.65	$1,330,230.72
Current Assets:			
Cash		$ 13,359.26	
Accounts Receivable		11,667.91	
Inventories:			
Supply Department	$ 38,976.75		
Biological Bulletin	11,069.82	50,046.57	
Investments:			
Devil's Lane Property	$ 45,099.78		
Gansett Property	6,030.81		
Stock in General Biological Supply House, Inc.	12,700.00		
Other Investment Stocks	17,770.00		
Securities, Real Estate and Cash—Retirement Fund—Schedule V	15,504.33	97,104.92	
Prepaid Insurance		3,445.81	
Items in Suspense		172.40	$ 175,796.87

EXHIBIT A—*Continued*

Liabilities

Endowment Funds:			
Endowment Funds—Schedule III	$1,105,900.37		
Reservation for Amortization of Bond Premiums	1,457.40	$1,107,357.77	
Minor Funds—Schedule III		9,194.41	$1,116,552.18
Plant Liabilities and Surplus:			
Donations and Gifts—Schedule III		$1,104,666.73	
Other Investments in Plant from Gifts and Current Funds		225,563.99	$1,330,230.72
Current Liabilities and Surplus:			
Accounts—Payable		$ 3,689.51	
Current Surplus—Exhibit C		172,107.36	$ 175,796.87

EXHIBIT B

Marine Biological Laboratory Income and Expense
Year Ended December 31, 1940

	Total		Net	
	Expense	Income	Expense	Income
Income:				
General Endowment Fund		$ 35,674.49		$ 35,674.49
Library Fund		8,463.30		8,463.30
Instruction	$ 10,283.63	9,670.00	$ 613.63	
Research	6,086.18	15,068.00		8,981.82
Evening Lectures	32.90		32.90	
Biological Bulletin and Membership Dues	8,834.37	9,725.93		891.56
Supply Dept.—Schedule VI	27,345.79	32,376.45		5,030.66
Mess—Schedule VIII	25,081.97	24,227.77	854.20	
Dormitories—Schedule VIII	23,658.88	13,060.53	10,598.35	
(Interest and Depreciation charged to above 3 Departments—See Schedules VI, VII, and VIII)	24,040.85			24,040.85
Dividends, General Biological Supply House, Inc.		18,542.00		18,542.00
Dividends, Crane Company		400.00		400.00
Rents:				
Bar Neck Property		5,097.64		5,097.64
Howes Property	117.80	160.00		42.20
Janitor House	24.07	360.00		335.93
Danchakoff Cottages	307.77	715.00		407.23
Sale of Library Duplicates		80.26		80.26
Apparatus Rental		1,226.53		1,226.53
Sundry Income		57.50		57.50
Maintenance of Plant:				
Buildings and Grounds	25,121.47		25,121.47	
Chemical and Special Apparatus Expense	15,833.22		15,833.22	
Library Expense	7,675.89		7,675.89	
Workmen's Compensation Insurance	538.14		538.14	
Truck Expense	466.96		466.96	
Bay Shore Property	77.40		77.40	
Great Cedar Swamp	19.20		19.20	
General Expenses:				
Administration Expense	12,426.64		12,426.64	
Endowment Fund Trustee and Safekeeping	1,014.45		1,014	
Interest on Notes Payable	87.50		87 50	
Bad Debts	228.66		228.66	
Reserve for Depreciation	25,648.22		25,648.22	
	$166,870.26	$174,905.40	$101,236.83	$109,271.97
Excess of Income over Expense carried to Current Surplus	8,035.14		8,035.14	
Exhibit C	$174,905.40		$109,271.97	

EXHIBIT C

Marine Biological Laboratory, Current Surplus Account
Year Ended December 31, 1940

Balance, January 1, 1940			$163,206.29
Add:			
Excess of Income Over Expense for Year as shown in Exhibit B		$ 8,035.14	
Reserve for Depreciation Charged to Plant Funds		25,648.22	
Transfer from Reserve for Repairs and Replacements on account of Hurricane Water-Damage		1,072.68	$ 34,756.04
			$197,962.33
Deduct:			
Payments from Current Funds during Year for Plant Assets as shown in Schedule IV,			
Buildings	$ 1,426.71		
Equipment	5,465.65		
Library	10,104.08	$16,996.44	
Less Received for Plant Assets Disposed of	$ 162.43		
Loss on Equipment Charged Off Due to Hurricane Water-Damage	131.74	294.17	
		$16,702.27	
Payment of Plant Note—Payable		$ 3,500.00	
Transfer to Plant Reserve Fund		2,500.00	
Pensions Paid	$ 3,710.00		
Less Retirement Fund Income	557.30	3,152.70	$ 25,854.97
Balance, December 31, 1940—Exhibit A			$172,107.36

Respectfully submitted,

Lawrason Riggs, Jr.,
Treasurer.

APPENDIX TO CHAPTER V

V, A, 1

INSTITUTIONS REPRESENTED AT THE MARINE BIOLOGICAL LABORATORY, 1888–1941

State	Secondary Schools	Normal Schools and Junior Colleges	Colleges, Universities, and Foundations	Medical Schools and Hospitals	Research Insts., Museums, Govt. Bureaus	Total
Alabama	0	1	5	1	0	7
Arizona	0	0	1	0	1	2
Arkansas	0	0	2	0	0	2
California	1	2	9	1	1	14
Colorado	0	0	3	0	1	4
Connecticut	6	3	8	1	1	19
Delaware	0	0	1	0	0	1
Dist. Columbia	5	0	3	2	11	21
Florida	0	0	2	0	0	2
Georgia	1	2	9	2	0	14
Idaho	0	0	1	0	0	1
Illinois	28	2	20	8	1	59
Indiana	5	1	9	1	1	17
Iowa	0	0	11	0	0	11
Kansas	3	2	7	1	0	13
Kentucky	1	1	5	1	0	8
Louisiana	1	1	5	0	0	7
Maine	1	3	4	0	1	9
Maryland	6	1	11	3	2	23
Massachusetts	47	4	19	3	3	76
Michigan	7	3	10	0	1	21
Minnesota	5	0	7	1	0	13
Mississippi	0	1	8	0	0	9
Missouri	10	5	5	3	1	24
Montana	0	1	1	0	0	2
Nebraska	4	0	3	2	0	9
New Hampshire	3	1	6	0	0	10
New Jersey	11	3	8	0	1	[illegible]
New York	54	10	41	20	15	[illegible]
North Carolina	1	2	11	0	0	14
North Dakota	0	0	3	0	[illegible]	3
Ohio	13	0	22	9	[illegible]	47
Oklahoma	0	1	3	0	[illegible]	4
Oregon	0	1	3	0	[illegible]	4
Pennsylvania	22	3	35	7	4	71
Rhode Island	6	1	3	1	0	11
South Carolina	0	0	9	0	0	9
South Dakota	0	0	2	0	0	2
Tennessee	0	2	8	1	0	11
Texas	3	1	7	2	0	13
Utah	0	0	1	0	0	1
Vermont	3	1	4	1	1	10
Virginia	2	2	10	2	1	17

INSTITUTIONS REPRESENTED AT THE MARINE BIOLOGICAL LABORATORY, 1888–1941—*Continued*

State	Secondary Schools	Normal Schools and Junior Colleges	Colleges, Universities, and Foundations	Medical Schools and Hospitals	Research Insts., Museums, Govt. Bureaus	Total
Washington	1	1	3	0	0	5
West Virginia	1	0	4	1	0	6
Wisconsin	5	7	9	0	2	23
Wyoming	0	0	1	0	0	1
Forty-six states and District of Columbia	256	69	362	74	52	813
State unknown	18	1	8	1	2	30
North and South American, other than U.S.						25
European, including British Isles						97
Other foreign						34
Total foreign						156
Total number of institutions represented, 1888–1941						999

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CO-OPERATING AND SUBSCRIBING INSTITUTIONS, 1892–1940

(Numbers in parenthesis represent number of years of subscription.)

Alabama

St. Bernard College, 1923–24 (2)
Spring Hill College, 1938 (1)
University of Alabama, 1927–1929 (3)

Arizona

Museum of Northern Arizona, 1933 (1)

Arkansas

University of Arkansas, 1923, 1927 (2)

California

California Institute of Technology, 1929–1932, 1935, 1937, 1939 (7)
Stanford University, 1940 (1)

Connecticut

Connecticut College, 1920–1923, 1927, 1938–1939 (7)
Wesleyan University, 1919–1940 (22)
Yale University, 1908–1940 (33)
Yale University Medical School, 1940 (1)

Delaware

University of Delaware, 1922, 1929 (2)

District of Columbia

American University, 1931, 1933–34, 1936–1938 (6)
Carnegie Institution of Washington, 1903–1905, 1915, 1919, 1922–1932, 1938–1939 (18)
George Washington University, 1924 (1)
Howard University, 1927–1931, 1939 (6)
U.S. Army Medical Department, 1923–1926 (4)
U.S. Department of Agriculture, 1900–1902, 1907, 1924, 1926–1931 (11)
U.S. Veterans Bureau, 1922–1923 (2)

Georgia

Agnes Scott College, 1929 (1)
Atlanta University, 1933–1937, 1939 (6)
Morehouse College, 1929–1937, 1939 (10)
University of Georgia Medical School, 1927, 1937 (2)

Illinois

Illinois Medical College, 1900–1901 (2)
Illinois Wesleyan University, 1921–1924 (4)
Knox College, 1920–1927 (8)
Lake Forest University, 1894–1897, 1916–1920, 1922 (10)
Loyola University, 1931 (1)
Mundelein College, 1939 (1)
Northwestern University, 1892–1903, 1906, 1909–1911, 1913–1916, 1923–1924, 1934–1941 (29)
Rush Medical College, 1900–1903 (4)
University of Chicago, 1892–1940 (49)
University of Chicago Medical School, 1931, 1935 (2)
University of Illinois, 1910–1932, 1934–1940 (20)

Indiana

Butler University, 1919–1925, 1927–1931, 1935 (13)
DePauw University, 1922–1940 (19)
Indiana University, 1919, 1925, 1930–1931 (4)
Eli Lilly and Co., 1919–1940 (22)
Purdue University, 1935–1940 (6)
University of Notre Dame, 1923, 1938–1939 (3)
Wabash College, 1912, 1914, 1921–1923, 1925–1930, 1932–1938 (19)

Iowa

Iowa State College, 1934–1939 (6)
Morningside College, 1927 (1)
State University of Iowa, 1926, 1931–1940 (11)

Kansas

Kansas State Agricultural College, 1913–1916, 1918–1919 (6)
University of Kansas, 1900–1906, 1911–1912, 1914–1922, 1927, 1929, 1934, 1936, 1940 (23)
University of Kansas Women's Table, 1900–1910 (11)

Kentucky
Berea College, 1928, 1934–1935 (3)

Louisiana
H. Sophie Newcomb College, 1916–1920, 1922–1934, 1940 (19)

Maine
Bowdoin College, 1893, 1915–1917, 1919–1940 (26)
University of Maine, 1923 (1)
Western State Normal School, 1920–1921 (2)

Maryland
Goucher College, 1894–1940 (47)
Johns Hopkins University, 1914–1940 (27)
Johns Hopkins University Medical School, 1922, 1925–31, 1933–1934, 1939–1940 (12)
St. John's College, 1935, 1937–1939 (4)
St. Mary's Seminary, 1923 (1)
University of Maryland, 1922, 1926 (2)
University of Maryland Medical School, 1926–1929, 1936–1939 (8)

Massachusetts
Amherst College, 1914–1916, 1918–1919, 1922–1940 (24)
Boston University School of Medicine, 1894–1897 (4)
Clark University, 1916, 1924 (2)
Harvard University, 1913–1940 (28)
Harvard University Medical School, 1912, 1914, 1918–1936, 1938–1940 (24)
Massachusetts Agricultural College, 1910 (1)
Massachusetts Institute of Technology, 1892–1897, 1921–1922, 1924–1929 (14)
Massachusetts State College, 1937–1940 (4)
Mount Holyoke College, 1892–1940 (49)
Radcliffe College, 1913–1931, 1933–1938, 1940 (26)
Simmons College, 1917, 1919–1921, 1924–1925 (6)
Smith College, 1893–1921, 1923–1940 (47)
Springfield College, 1940 (1)
Tufts College, 1921–1936, 1938–1940 (19)
Wellesley College, 1892–1917, 1919–1940 (48)
Wheaton College, 1918–1920, 1930–1940 (14)
Williams College, 1892–1897, 1900–1902, 1904–1905, 1908, 1912, 1921, 1933, 1938–1939 (17)

Michigan
Battle Creek College, 1901, 1926, 1929 (3)
University of Michigan, 1900–1930, 1934 (32)

Minnesota
Carleton College, 1912–1914, 1916–1918, 1923, 1928 (8)
College of St. Benedict, 1931 (1)
College of St. Catherine, 1932 (1)
University of Minnesota, 1922–1928, 1931, 1936–1938 (11)
University of Minnesota Medical School, 1927 (1)

Missouri
Missouri Botanical Garden, 1892–1897 (6)
St. Louis University, 1924, 1930 (2)

University of Missouri, 1909, 1913, 1917, 1919–21, 1923–1932, 1935–1936, 1938–1940 (21)
Washington University, 1920–1932, 1937–1940 (17)
Washington University Medical School, 1923–1931, 1937–1940 (13)

Nebraska

Creighton University, 1917–1921 (5)
Doane College, 1914, 1917, 1920, 1923–1924 (5)
University of Nebraska, 1921, 1925, 1929–1930 (4)

New Hampshire

Dartmouth College, 1910–1928, 1931–1932, 1937–1939 (24)

New Jersey

Brothers College of Drew University, 1938–1939 (2)
College of St. Elizabeth, 1932–1934 (3)
Princeton University, 1893–1900, 1909–1940 (40)
Rutgers University, 1914–1917, 1922, 1924–1934, 1937–1940 (20)

North Carolina

Duke University, 1911, 1920, 1925, 1927–1940 (17)
High Point College, 1925 (1)
Johnson C. Smith University, 1934–1935 (2)
North Carolina College for Negroes, 1940 (1)
North Carolina College for Women (University of North Carolina), 1922–1924, 1927–1928 (5)

New York

American Museum of Natural History, 1923, 1928 (2)
Barnard College, 1901–1903, 1913–1924, 1927–1929, 1931–1932, 1934–1935, 1938, 1940 (24)
Brooklyn College, 1940 (1)
Buffalo Society of Natural History, 1925–1926 (2)
Canisius College, 1939–1940 (2)
Carnegie Institution, Cold Spring Harbor, 1920, 1922, 1926–1929, 1931 (7)
College of Physicians and Surgeons, 1894–1897, 1917, 1921–1923, 1925, 1935, 1937–1940 (14)
College of the City of New York, 1900–1901 (2)
Columbia University, 1892–1940 (49)
Cornell University, 1921–1927, 1929–1937, 1940 (17)
Cornell University Medical College, 1918–1940 (23)
Elmira College, 1923–1925, 1927–1932, 1938–1939 (11)
Hamilton College, 1893–1897, 1900–1902, 1926, 1928–1933, 1935–19 .9)
Hunter College, 1912–1927, 1930–1940 (27)
Long Island University, 1931–1940 (10)
Memorial Hospital of New York City, 1928–1933, 1935–1940
Mount Sinai Hospital, 1940 (1)
New York Homeopathic Medical College, 1927 (1)
New York State Department of Health, 1930–1940 (11)
New York University, 1919, 1923–1940 (19)
New York University Dental School, 1926–1927 (2)
New York University Medical School, 1926, 1932–1938, 1940 (9)

New York University, Washington Square College, 1939–1940 (2)
Rensselaer Polytechnic Institute, 1936 (1)
Rockefeller Institute for Medical Research, 1910–1940 (31)
Russell Sage College, 1940 (1)
Syracuse University, 1894–1903, 1905, 1907–1908, 1910–1913, 1915, 1931–1940 (28)
Syracuse University College of Medicine, 1894–1902, 1940 (10)
Union College, 1923–1927, 1929–1931, 1935–1940 (14)
University of Buffalo, 1928–1931 (4)
University of Buffalo School of Medicine, 1939 (1)
University of Rochester, 1892–1893, 1902–1907, 1909–1910, 1912–1914, 1916, 1919–1920, 1923, 1925–1940 (33)
University of Rochester Medical School, 1928, 1933–1935, 1937–1938 (6)
Vassar College, 1892–1940 (49)

Ohio

Antioch College, 1923–1928, 1930 (7)
Children's Hospital of Cincinnati, 1935 (1)
Christ Hospital of Cincinnati, 1935 (1)
Kenyon College, 1937–1938 (2)
Miami University, 1892–1901, 1924 (11)
Nela Research Laboratory, 1921–1924 (4)
Oberlin College, 1909–1940 (32)
Ohio State University, 1940 (1)
Ohio University, 1929 (1)
Ohio Wesleyan University, 1924–1926 (3)
St. Xavier College, 1936 (1)
University of Cincinnati, 1892–1897, 1907, 1911–1914, 1917, 1919–1926, 1928–1940 (33)
University of Toledo, 1938–1939 (2)
Western College for Women, 1911–1912, 1914–1915 (4)
Western Reserve University, 1919–1923, 1926–1931, 1935, 1937–1939 (15)

Pennsylvania

Beaver College, 1930 (1)
Biological Institute, 1940 (1)
Bryn Mawr College, 1892–1906, 1911, 1913, 1916, 1918–1940 (43)
Carnegie Institute of Technology, 1914–1916, 1922 (4)
Johnson Foundation, University of Pennsylvania, 1936 (1)
Lafayette College, 1923, 1926 (2)
Lincoln University, 1935 (1)
Pennsylvania State School of Forestry, 1908 (1)
St. Vincent's College, 1923–1924 (2)
Seton Hill College, 1929–1932, 1935–1937 (7)
Swarthmore College, 1927–1928, 1930, 1933–1938 (9)
Temple University, 1901, 1934–1939 (7)
University of Pennsylvania, 1894–1940 (47)
University of Pennsylvania School of Dentistry, 1927–1928 (2)
University of Pennsylvania Medical School, 1920, 1924–1937, 1939–1940 (17)
University of Pittsburgh, 1927–1940 (14)

Villanova College, 1939–1940 (2)
Wilson College, 1924–1925, 1931–1935, 1937–1940 (11)
Wistar Institute of Anatomy and Biology, 1908–1937 (30)
Woman's College of Pennsylvania (Pennsylvania College for Women), 1901, 1928–1939 (13)
Woman's Medical College, 1929–1930 (2)

Rhode Island
Brown University, 1892–1897, 1904, 1906, 1925–1932, 1938–1940 (19)
Rhode Island State College, 1914 (1)

South Carolina
College of Charleston, 1936–1937 (2)
Presbyterian College of South Carolina, 1924 (1)

Tennessee
Fisk University, 1932, 1940 (2)
Southwestern College, 1922, 1927–1931 (6)
Vanderbilt University, 1924, 1935 (2)
Vanderbilt University Medical School, 1927–1940 (14)

Texas
Rice Institute, 1916–1920, 1937 (6)
University of Texas, 1894–1897, 1901, 1912, 1915–1916, 1931 (9)

Vermont
Norwich University, 1927 (1)
University of Vermont, 1919, 1922, 1924–1929, 1931–1932, 1935, 1938 (12)

Virginia
College of William and Mary, 1938–1939 (2)
Medical College of Virginia, 1937 (1)
Sweet Briar College, 1922–1923 (2)
University of Virginia, 1921, 1924–1932, 1934–1940 (17)

West Virginia
West Virginia State College, 1930, 1933 (2)
West Virginia University, 1929–1931 (3)

Wisconsin
Beloit College, 1914, 1932 (2)
St. Norberts College, 1923–1924, 1929 (3)
University of Wisconsin, 1914–1933, 1935–1937 (13)
Woman's School Alliance of Milwaukee, 1894–1897 (4)

Philippines
University of the Philippines, 1920–1922, 1924 (4)

Canada
McGill University, Montreal, 1900–1906, 1908, 1912, 1914, 19[illegible]25, 1927–1928, 1939 (15)
Acadia University, Nova Scotia, 1929–1932 (4)
Dalhousie University, Nova Scotia, 1926–1928, 1930–1932, 1934, 1938–1939 (9)
University of Toronto, 1920 (1)

Europe
Kaiser Wilhelm Institut für Biologie, Germany, 1916–1917 (2)

V, A, 3

SUBSCRIBING AND CO-OPERATING INSTITUTIONS 1941

American University
Amherst College
Barnard College
Biological Institute, Philadelphia
Bowdoin College
Brooklyn College
Brown University
Bryn Mawr College
Canisius College
California Institute of Technology
College of Physicians and Surgeons
Columbia University
Cornell University
Cornell University Medical College
DePauw University
Duke University
Fordham University
Goucher College
Hamilton College
Harvard University
Harvard University Medical School
Indiana University
Industrial and Engineering Chemistry, of the American Chemical Society
Johns Hopkins University
Eli Lilly & Company
Loyola University of the South
Josiah Macy Jr. Foundation
Massachusetts State College
Mount Holyoke College
Mount Sinai Hospital, New York City
Mundelein College
New York State Department of Health
New York University
New York University College of Medicine
New York University, Washington Square College
Northwestern University
Oberlin College
Ohio State University
Ohio Wesleyan University
Princeton University
Purdue University
Radcliffe College
Rockefeller Foundation
Rockefeller Institute for Medical Research
Russell Sage College
Rutgers University
Sarah Lawrence College
Seton Hill College
Smith College
Springfield College
State University of Iowa
Syracuse University
Tufts College
Tulane University
Union College
University of Chicago
University of Cincinnati
University of Illinois
University of Maryland Medical School
University of Michigan
University of Missouri
University of Pennsylvania
University of Pennsylvania Medical School
University of Pittsburgh
University of Rochester
University of Toledo
University of Virginia
Vanderbilt University Medical School
Vassar College
Villanova College
Wabash College
Washington University
Washington University Medical School
Wellesley College
Wesleyan University
Wheaton College
Yale University
Yale University Medical School

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BY-LAWS OF THE CORPORATION OF THE MARINE BIOLOGICAL LABORATORY

1940

I. The annual meeting of the members shall be held on the second Tuesday in August, at the Laboratory, in Woods Hole, Mass., at 11:30 A.M., daylight saving time, in each year, and at such meeting the members shall choose by ballot a Treasurer and a Clerk to serve one year, and eight Trustees to serve four years. There shall be thirty-two Trustees thus chosen divided into four classes, each to serve four years, and in addition there shall be two groups of Trustees as follows: (*a*) Trustees *ex officio*, who shall be the President of the Corporation, the Director of the Laboratory, the Associate Director, the Treasurer and the Clerk; (*b*) Trustees Emeritus, who shall be elected from the Trustees by the Corporation. Any regular Trustee who has attained the age of seventy years shall continue to serve as Trustee until the next annual meeting of the Corporation, whereupon his office as regular Trustee shall become vacant and be filled by election by the Corporation and he shall become eligible for election as Trustee Emeritus for life. The Trustees *ex officio* and Emeritus shall have all rights of the Trustees except that Trustees Emeritus shall not have the right to vote.

II. Special meetings of the members may be called by the Trustees to be held in Boston or in Woods Hole at such time and place as may be designated.

III. Inasmuch as the time and place of the Annual Meeting of Members is fixed by these By-laws, no notice of the Annual Meeting need be given. Notice of any special meeting of members, however, shall be given by the Clerk by mailing notice of the time and place and purpose of said meeting, at least fifteen (15) days before such meeting, to each member at his or her address as shown on the records of the Corporation.

IV. Twenty-five members shall constitute a quorum at any meeting.

V. The Trustees shall have the control and management of the affairs of the Corporation; they shall present a report of its condition at every annual meeting; they shall elect one of their number President of the Corporation who shall also be Chairman of the Board of Trustees; they shall appoint a Director of the Laboratory; and they may choose such other officers and agents as they may think best; they may fix the compensation and define the duties of all the officers and agents; and may remove them, or any of them, except those chosen by the members, at any time; they may fill vacancies occurring in any manner in their own number or in any of the offices. They shall from time to time elect members to the Corporation upon such terms and conditions as they may think best.

VI. Meetings of the Trustees shall be called by the President, or by any two Trustees, and the Secretary shall give notice thereof by written or printed notice sent to each Trustee by mail, postpaid. Seven Trustees shall constitute a quorum for the transaction of business. The Board of Trustees shall have power to choose an Executive Committee from their own number, and to delegate to such Committee such of their own powers as they may deem expedient.

VII. The accounts of the Treasurer shall be audited annually by a certified public accountant.

VIII. The consent of every Trustee shall be necessary to dissolution of the Marine Biological Laboratory. In case of dissolution, the property shall be disposed of in such manner and upon such terms as shall be determined by the affirmative vote of two-thirds of the Board of Trustees.

IX. These By-laws may be altered at any meeting of the Trustees, provided that the notice of such meeting shall state that an alteration of the By-laws will be acted upon.

X. Any member in good standing may vote at any meeting, either in person or by proxy duly executed.

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TRUSTEES OF THE MARINE BIOLOGICAL LABORATORY AS OF AUGUST 11, 1942

Ex Officio

Lawrason Riggs, President of the Corporation, New York City.
E. Newton Harvey, Vice President, Princeton University.
Charles Packard, Director, Columbia University.
Donald M. Brodie, Treasurer, New York City.
Otto C. Glaser, Clerk, Amherst College.

Emeritus

H. C. Bumpus, Brown University.
G. N. Calkins, Columbia University.
E. G. Conklin, Princeton University.
Caswell Grave, Washington University.
R. A. Harper, Columbia University.
R. G. Harrison, Yale University.
H. S. Jennings, University of California.
Frank R. Lillie, President Emeritus of the Corporation, The University of Chicago.
S. O. Mast, Johns Hopkins University.
A. P. Mathews, University of Cincinnati.
C. E. McClung, University of Pennsylvania.
T. H. Morgan, California Institute of Technology.
W. J. V. Osterhout, Rockefeller Institute.
G. H. Parker, Harvard University.
W. B. Scott, Princeton University.

To Serve until 1946

D. E. S. Brown, New York University.
E. R. Clark, University of Pennsylvania.
Otto C. Glaser, Amherst College.
E. N. Harvey, Princeton University.
M. H. Jacobs, University of Pennsylvania.

F. P. Knowlton, Syracuse University.
Franz Schrader, Columbia University.
B. H. Willier, Johns Hopkins University.

To Serve until 1945

W. R. Amberson, University of Maryland School of Medicine.
S. C. Brooks, University of California.
W. C. Curtis, University of Missouri.
H. B. Goodrich, Wesleyan University.
I. F. Lewis, University of Virginia.
R. S. Lillie, University of Chicago.
A. C. Redfield, Harvard University.
C. C. Speidel, University of Virginia.

To Serve until 1944

Eric Ball, Harvard University Medical School.
E. F. DuBois, Cornell University Medical College.
R. Chambers, New York University, Washington Square College.
W. E. Garrey, Vanderbilt University Medical School.
Columbus Iselin, Woods Hole Oceanographic Institution.
C. W. Metz, University of Pennsylvania.
H. H. Plough, Amherst College.
W. R. Taylor, University of Michigan.

To Serve until 1943

W. C. Allee, University of Chicago.
G. H. A. Clowes, Lilly Research Laboratory.
B. M. Duggar, University of Wisconsin.
L. V. Heilbrunn, University of Pennsylvania.
Laurence Irving, Swarthmore College.
J. H. Northrop, Rockefeller Institute.
A. H. Sturtevant, California Institute of Technology.
L. L. Woodruff, Yale University.

Executive Committee of the Board of Trustees

August 11, 1942

Lawrason Riggs, *ex officio*, Chairman
E. N. Harvey, *ex officio*.
D. M. Brodie, *ex officio*.
Charles Packard, *ex officio*.
D. E. S. Brown, Class of 1943.
B. H. Willier, Class of 1943.
C. W. Metz, Class of 1944.
Otto C. Glaser, Class of 1944.

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TRUSTEES OF THE MARINE BIOLOGICAL LABORATORY
1888–1942

Allee, W. C., University of Chicago, 1932——
Amberson, W. R., University of Maryland Medical School, 1933——
Armstrong, P. B., Syracuse University Medical School, 1938–1942 (Clerk)
Ball, Eric, Harvard University, 1942——
Bartlett, A. C., Chicago, Illinois, 1901–1902
Bigelow, H. B., Harvard University, 1932–1941
Bradley, H. C., University of Wisconsin, 1929–1933
Britton, N. L., New York, New York, 1909–1911
Brodie, D. M., New York, New York, 1942—— (Treasurer)
Brooks, S. C., University of California, 1941——
Brooks, W. K., Johns Hopkins University, 1893–1897; 1898–1908
Brown, D. E. S., New York University, 1940——
Bumpus, H. C., Brown University, 1897–1899 (Assistant Director 1894–95; Clerk 1897–1899); 1900–1932; Emeritus 1932–1943
Cabot, E. T., Boston, Massachusetts, 1890–1893 (Treasurer)
Calkins, G. N., Columbia University, 1912–1930 (Clerk); 1931–1939; Emeritus 1939–1942
Chambers, R., New York University, Washington Square College, 1929——
Clapp, Cornelia M., Mount Holyoke College, 1900–1904 (Clerk 1903); 1910–1922; Emeritus 1922–1934
Clark, E. R., University of Pennsylvania, 1930——
Clarke, S. F., Williams College, 1891–1921
Clowes, G. H. A., Lilly Research Laboratory, 1941——
Conklin, E. G., Princeton University, 1897–1934; Emeritus 1934——
Coolidge, C. A., Boston, Massachusetts, 1901–1921
Crampton, H. E., Barnard College, 1925–1927
Crane, C. R., Chicago, Illinois, 1901–1929 (President 1904–1924); Emeritus 1929–1939
Curtis, W. C., University of Missouri, 1923–1935; 1937——
Cushing, Florence M., Boston, Massachusetts, 1887–1897
Donaldson, H. H., Wistar Institute of Anatomy and Biology, 1912–1929; Emeritus 1929–38
Drew, G. A., University of Maine, 1907–1924 (Assistant Director); Emeritus 1925–1934
DuBois, E. F., Cornell University Medical College, 1942——
Duggar, B. M., University of Wisconsin, 1927——
Dunbar, W. H., Boston, Massachusetts, 1923 (Treasurer)
Farlow, W. G., Harvard University, 1887–1897 (Acting President 1896–1897)
Ganong, W. F., Smith College, 1900–1902
Gardiner, E. G., Massachusetts Institute of Technology, 1890–1907 (Clerk 1895–1897, 1900–1902, 1906–1907)
Garrey, W. E., Vanderbilt University Medical School, 1920——

Glaser, Otto C., Amherst College, 1922—— (Clerk 1942——)
Goodrich, H. B., Wesleyan University, 1931——
Grave, Caswell, Washington University, 1920–1940; Emeritus 1940——
Greenman, M. J., Wistar Institution of Anatomy and Biology, 1908–1936; Emeritus 1936–1937
Hargitt, C. W., Syracuse University, 1900–1920
Harper, R. A., Columbia University, 1911–1923; 1924–1932; Emeritus 1932——
Harrison, R. G., Yale University, 1908–1940; Emeritus 1940——
Harvey, E. N., Princeton University, 1929—— (Vice President, 1942——)
Heilbrunn, L. V., University of Pennsylvania, 1931——
Herter, C. A., Bellevue Medical School, 1900–1910
Hoar, D. Blakeley, Boston, Massachusetts, 1897–1922 (Treasurer)
Hyatt, Alpheus, Boston Society of Natural History, 1888–1889 (President)
Irving, Laurence, Swarthmore College, 1935——
Iselin, Columbus, Woods Hole Oceanographic Institution, 1941——
Jacobs, M. H., University of Pennsylvania, 1925–1938 (Assistant Director 1925 and Director 1926–1937); 1938——
Jennings, H. S., University of California, 1905–1920; 1922–1938; Emeritus 1938——
Kidder, C. G., New York, New York, 1897–1921
Knowlton, F. P., Syracuse University, 1922——
Lefevre, George, University of Missouri, 1909–1923
Lewis, I. F., University of Virginia, 1921——
Libbey, William, Princeton University, 1891–1910
Lillie, Frank R., University of Chicago, 1900–1942 (Assistant Director 1900–1908, Director 1908–1925 and President 1925–1942); Emeritus 1942——
Lillie, Ralph S., University of Chicago, 1921——
Locy, W. A., Northwestern University, 1898–1923
Loeb, Jacques, Rockefeller Institute, 1898–1923
Lowell, A. L., Boston, Massachusetts, 1890–1893 (Clerk)
Lyon, E. P., University of Minnesota, 1921–1931
Macfarlane, J. M., University of Pennsylvania, 1897–1903
Mall, F. P., Johns Hopkins University, 1897–1917
Mark, E. L., Harvard University, 1888
Mast, S. O., Johns Hopkins University, 1936–1942; Emeritus 1942——
Mathews, A. P., University of Cincinnati, 1905–1942; Emeritus 1942——
Mayor, A. G., Carnegie Institution of Washington, 1909–1921
McClung, C. E., University of Pennsylvania, 1913–1933; 1935–1940; Emeritus 1940——
McMurrich, J. P., University of Toronto, 1892–1901
Metcalf, M. M., Johns Hopkins University, 1897–1932; Emeritus 1932–1940
Metz, C. W., University of Pennsylvania, 1940——
Minns, Susan, Woman's Education Association, Boston, Mass., 1887–1894
Minot, C. S., Harvard University Medical School, 1887–1897
Minot, Laurence, Boston, Massachusetts, 1894–1897 (Treasurer 1894–1897, Clerk 1894)
Montgomery, T. H., Jr., University of Pennsylvania, 1908–1911 (Clerk)

Moore, G. T., Missouri Botanical Garden, 1907–1931
Morgan, T. H., California Institute of Technology, 1897–1937; Emeritus 1937——
Northrop, J. H., Rockefeller Institute, 1939——
Nunn, L. L., Telluride, Colorado, 1897–1923
Osborn, H. F., Columbia University, 1890–1902 (President 1897–1901)
Osterhout, W. J. V., Rockefeller Institute, 1919–1941; Emeritus 1941——
Packard, Charles, Columbia University, 1931—— (Clerk 1931–1937, Associate Director 1938–1940 and Director 1941——)
Parker, G. H., Harvard University, 1908–1935; Emeritus 1935——
Patten, William, Dartmouth College, 1897–1930; Emeritus 1930–1932
Peck, James I., Williams College, 1898 (Assistant Director)
Penhallow, D. P., McGill University, 1897–1910
Phillips, A. D. (Mrs. A. P. Williams), Boston, Mass., 1887–1897 (Clerk 1888–1890)
Phillips, J. C., Boston, Massachusetts, 1902–1919
Plough, H. H., Amherst College, 1940——
Porter, W. T., Harvard University Medical School, 1900–1905
Redfield, A. C., Harvard University, 1929——
Reighard, Jacob, University of Michigan, 1902–1922
Riggs, Lawrason, New York, New York, 1924–1942 (Treasurer); 1942——(President)
Schrader, Franz, Columbia University, 1932——
Schramm, J. R., University of Pennsylvania, 1923–1931
Scott, W. B., Princeton University, 1897–1929; Emeritus 1929——
Scudder, S. H., Cambridge, Massachusetts, 1890–1897 (President)
Sedgwick, W. T., Massachusetts Institute of Technology, 1887–1900
Sharp, Benjamin, Academy of Natural Science, Philadelphia, 1891–1896
Smith, E. F., United States Department of Agriculture, 1902–1921
Smith, Georgiana W., Boston, Massachusetts, 1891–1897
Smith, Sidney I., Yale University, 1891–1897
Speidel, C. C., University of Virginia, 1933——
Stevens, W. S., Boston, Massachusetts, 1887–1889 (Treasurer)
Stockard, C. R., Cornell University Medical College, 1920–1939
Sturtevant, A. H., California Institute of Technology, 1935——
Taylor, W. R., University of Michigan, 1939——
Tennent, D. H., Bryn Mawr College, 1921–1941
Trelease, W., Missouri Botanical Garden, 1892–1900
Ward, H. B., University of Illinois, 1914–1920
Wells, Samuel, Boston, Massachusetts, 1887–1889
Wheeler, W. M., Harvard University, 1919–1935; Emeritus 1935–1937
Whitman, C. O., University of Chicago, 1895–1910 (Director 1888–1907)
Wilcox, Alice, Woman's College, Brown University, 1904–1906 (Clerk)
Willier, B. H., Johns Hopkins University, 1934——
Wilson, E. B., Columbia University, 1890–1929; Emeritus 1929–1939
Wilson, W. P., University of Pennsylvania, 1894–1908
Woodruff, L. L., Yale University, 1923—— (Clerk *pro tem.* 1926–27)
Wright, R. R., University of Toronto, 1891–1900

TRUSTEES WHO HAVE SERVED FIFTEEN OR MORE YEARS

(As of 1942)

49 Years

Wilson, E. B.

46 Years

*Bumpus, H. C.
*Conklin, E. G.
*Morgan, T. H.
*Scott, W. B.

43 Years

Metcalf, M. M.
*Lillie, F. R.

38 Years

Crane, C. R.
*Jennings, H. S.
*Mathews, A. P.

35 Years

*Harrison, R. G.
*Parker, G. H.
Patten, William

32 Years

*Harper, R. A.

31 Years

*Calkins, G. N.
*Clarke, S. F.

30 Years

*McClung, C. E.

29 Years

Clapp, Cornelia M.
Greenman, M. J.

27 Years

Drew, G. A.
Nunn, L. L.

26 Years

Donaldson, H. H.

25 Years

Hoar, D. B.
Locy, W. A.
Loeb, Jacques
Moore, G. T.

24 Years

Kidder, C. G.
*Osterhout, W. J. V.

23 Years

*Garrey, W. E.
*Grave, Caswell

22 Years

*Lewis, I. F.
*Lillie, R. S.

21 Years

Coolidge, C. A.
*Glaser, O. C.
Hargitt, C. W.
*Knowlton, F. P.
Reighard, J.

20 Years

Libbey, William
Mall, F. P.
Smith, E. F.
Tennent, D. H.
*Woodruff, L. L.

19 Years

*Curtis, W. C.
*Riggs, Lawrason
Stockard, C. R.

18 Years

*Jacobs, M. H.
Phillips, J. C.
Wheeler, W. M.

17 Years

Gardiner, E. G.

16 Years

*Duggar, B. M.

15 Years

Brooks, W. K.
Whitman, C. O.
Wilson, W. P.

*Still on Board, 1942.

INSTITUTIONS REPRESENTED BY TRUSTEES OF THE MARINE BIOLOGICAL LABORATORY. (1888–1942)

Academy of Natural Science, Philadelphia, 1
American Museum of Natural History, 1
Amherst College, 2
Barnard College, 1
Bellevue Medical School, 1
Boston Society of Natural History, 1
Brown University, 1
Bryn Mawr College, 2
California Institute of Technology, 2
Carnegie Institution of Washington, 1
Columbia University, 7
Cornell University, 1
Cornell University Medical College, 2
Dartmouth College, 1
Goucher College, 1
Harvard University, 8
Harvard University Medical School, 2
Johns Hopkins University, 6
McGill University, Canada, 1
Massachusetts Institute of Technology, 2
Missouri Botanical Garden, 2
Mount Holyoke College, 1
Nela Research Laboratory, Cleveland, 1
New York University, 2
Northwestern University, 1
Oberlin College, 1
Princeton University, 4
Rockefeller Institute for Medical Research, 3
Smith College, 1
Swarthmore College, 1
Syracuse University, 3
Tufts College, 1
Tulane University, 1
University of California, 3
University of Chicago, 6
University of Cincinnati, 2
University of Illinois, 1
University of Maine, 1
University of Maryland Medical School, 1
University of Michigan, 3
University of Minnesota, 1
University of Missouri, 2
University of Pennsylvania, 11
University of Rochester, 1
University of Tennessee, 1
University of Toronto, Canada, 3
University of Virginia, 2
University of Wisconsin, 2
U.S. Department of Agriculture, 1
Vanderbilt University Medical School, 1
Washington University, 2
Wesleyan University, 1
Williams College, 2
Wistar Institute of Anatomy and Biology, 2
Woods Hole Oceanographic Institution, 2
Yale University, 3
Trustees not representing institutions, 21.

States Represented

California, 5
Colorado, 1
Connecticut, 4
District of Columbia, 2
Illinois, 10
Louisiana, 1
Maine, 1
Maryland, 8
Massachusetts, 35
Michigan, 3
Minnesota, 1
Missouri, 6
New Hampshire, 1
New Jersey, 5
New York, 25
Ohio, 4
Pennsylvania, 17
Rhode Island, 1
Tennessee, 2
Virginia, 2
Wisconsin, 2

Canada, 4

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OFFICERS OF THE MARINE BIOLOGICAL LABORATORY, 1888–1942*

President of the Corporation

1888–1889 ..... Alpheus Hyatt
1890–1897 ..... Samuel H. Scudder
1896–1897 (Acting Pres.) ..... Wm. G. Farlow
1897–1902 ..... Henry F. Osborn
1902–1903 .....
1904–1925 ..... Charles R. Crane
1925–1942 ..... Frank R. Lillie
1942——— ..... Lawrason Riggs

Vice President of the Corporation

1942——— ..... E. Newton Harvey

Clerk of the Corporation

1888–1889 ..... Anna Phillips Williams
1890–1893 ..... A. Lawrence Lowell
1894 ..... Laurence Minot
1895–1897 ..... Edward G. Gardiner
1897–1899 ..... H. C. Bumpus
1900–1902 ..... Edward G. Gardiner
1903 ..... Cornelia M. Clapp
1904–1906 ..... Alice M. Wilcox
1906–1907 ..... Edward G. Gardiner
1908–1911 ..... T. H. Montgomery, Jr.
1912–1926 ..... Gary N. Calkins
1926–1927 (*pro tem.*) ..... L. L. Woodruff
1928–1930 ..... Gary N. Calkins
1931–1937 ..... Charles Packard
1938–1942 ..... Philip B. Armstrong
1942——— ..... Otto C. Glaser

Treasurer of the Corporation

1888–1889 ..... Wm. Stanford
1890–1893 ..... Edward [illegible]ot
1894–1896 ..... Lauren[illegible] Minot
1897–1922 ..... D. Blakeley Hoar
1923 (interim) ..... William D. Dunbar
1924–1942 ..... Lawrason Riggs
1942——— ..... Donald M. Brodie

* After 1897 the years are dated from the annual meetings in August of each year.

DIRECTOR

1888–1907 . . . . . C. O. WHITMAN
1908–1925 . . . . . FRANK R. LILLIE
1926–1937 . . . . . MERKEL H. JACOBS
1938–1940 . . . . .
1941——— . . . . . CHARLES PACKARD

ASSISTANT DIRECTOR

1894–1895 . . . . . H. C. BUMPUS
1896–1898 . . . . . JAMES I. PECK
1899 . . . . . ULRIC DAHLGREN
1900–1908 . . . . . FRANK R. LILLIE
1909–1924 . . . . . GILMAN A. DREW
1925 . . . . . MERKEL H. JACOBS
1926–1937 . . . . .
1938–1940 (Associate Director) . . . . . CHARLES PACKARD

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To the Members of the Corporation of the Marine Biological Laboratory:

THE REPORT OF THE MANAGING EDITOR OF THE BIOLOGICAL BULLETIN[1]

The *Biological Bulletin* is the property of the members of the Corporation of the Marine Biological Laboratory. It is the one tangible return which they receive in exchange for their membership fees, whether they return each year to the laboratory or not. It seems proper that you should receive, at least from time to time, some report on its progress, its policies and problems.

The annual reports of the Laboratory contain only occasional references to the *Bulletin*, recording appointments to the editorial board and such matters of fact. Fortunately there is preserved in the Tenth Report, for the years 1903–1906, a prospectus issued in 1902 announcing the resumption of publication of the *Bulletin*, which had been interrupted for a year. With the completion of the eightieth volume, after thirty-nine years of continuous publication, it is not unfitting to re-examine this prospectus and see to what extent its promise has been realized.

The *Biological Bulletin* was preceded by the *Zoölogical Bulletin*, of which two volumes were published in 1897 and 1898 under the editorship of Professor C. O. Whitman, then Director of the Laboratory, and Professor W. M. Wheeler. It was intended to be a companion journal to the *Journal of Morphology* and to take in shorter papers with simple illustrations, where relatively rapid publication of original contributions was desirable. Following the completion of two volumes, it was succeeded in 1899 by Volume I of the *Biological Bulletin*. The title page of the new *Biological Bulletin* shows it to have been edited by the Director and members of the staff of the Marine Biological Laboratory. Volume II was completed in June, 1901.

[1] From the *Annual Report, 1940.*

After the lapse of a year, Volume III appeared, bearing the title: *Biological Bulletin of the Marine Biological Laboratory, Woods Hole, Mass.*, thus clearly establishing the relation of the publication to the Laboratory. The treasurer's report for 1902 shows also that for the first time the relationship was a material one. The editorial staff consisted of E. G. Conklin, The University of Pennsylvania; Jacques Loeb, The University of Chicago; T. H. Morgan, Bryn Mawr; W. M. Wheeler, The University of Texas; C. O. Whitman, The University of Chicago; E. B. Wilson, Columbia University; and Frank R. Lillie appeared for the first time as Managing Editor. Dr. Lillie continued to edit the *Bulletin* for 25 years, when in 1927 he was succeeded by Dr. Carl R. Moore. With two other members of the original staff he still serves as a member of the editorial board.

The prospectus announcing the resumption of publication stated that:

> The Bulletin will be published as heretofore, under the auspices of the Marine Biological Laboratory, and its scope will include Zoölogy, General Biology, and Physiology. It will contain original articles in these fields and also occasional reviews, and reports of work and lectures at the Marine Biological Laboratory. Preliminary statements of important results will be made a special feature. The Bulletin will be open, as heretofore, to contributions from any source.

I think it is fair to say that the scope of the *Bulletin* still includes Zoölogy, General Biology, and Physiology and that the character of its contents remains essentially unchanged except as it reflects changing emphasis and new developments within these fields. The question of scope is, nevertheless, one of the most perplexing problems of policy with which the managing editor must deal. The object of the Laboratory and the curiosity of its clientele are broad, and it seems proper that the contents of the *Bulletin* should reflect this catholic interest. It is not undesirable in this day of specialization that one journal at least should present a rather broad cross-section of biology as a whole. On the other hand, practical considerations require some limitation, even within the fields specified in the prospectus, and there is no easier way for an editor to dispose of an unwelcome manuscript than to rule it inappropriate. There is also an evil temptation which besets every editor to allow the selection of papers to reflect too closely his own particular interests and prejudices. I think that in the selection of papers, the guiding principle should be to produce a journal which will interest as widely as possible those who support it with their subscriptions. These are primarily the members of this Corporation, and secondarily, the biological libraries throughout the world. The character of both of these groups argues for as great as diversity a possible. Worthy papers differ greatly in the breadth of their interest. Many papers contain material of value to specialists which are of little interest to other biologists. Where specialists maintain their own journals, as is true, for example, in mammalian physiology, or genetics, it seems preferable that such papers should be published in these places. For many years it was the policy of the *Bulletin* not to publish taxonomic papers since taxonomy was not a part of the program of the Marine Biological Laboratory. However, I feel that today those who are still following the older disciplines deserve some encouragement and that the policy of the *Bulletin* should be more lenient, at least in connection with papers dealing with the local fauna and with groups of organisms which are not covered by specialized journals.

It is significant that the founders of the *Biological Bulletin* did not call it the *Marine Biological Bulletin*, though it was published under the auspices of a marine laboratory.

It is evident that they came to Woods Hole not so much to study the sea, but because they found there good material for the study of more general problems, and that they intended that the *Bulletin* should represent all aspects of biology. In this characteristic there has been no change. It is, however, natural that the journal should deal to a large extent with the biology of marine organisms since these are the creatures on which many of your studies are made, and it seems reasonable to assume that you will be interested in papers of all sorts dealing with these organisms and with the waters in which they live. Thus the *Bulletin* should retain a distinctly salty flavor and should welcome especially work done at other marine stations.

The prospectus states that the *Bulletin* will be open to contributions "from any source." An examination of 778 papers published between 1930–1940 shows that 29 per cent originated from this Laboratory; 22 per cent were contributions from other marine laboratories, including 9 per cent derived from the Woods Hole Oceanographic Institution. These included contributions from: the Mt. Desert Island Biological Laboratory, the Scripps Institution of Oceanography, the Duke University Marine Laboratory, the William Kerckhoff Marine Biological Laboratories of the California Institute of Technology, the Hopkins Marine Station, the U.S. Bureau of Fisheries, the Atlantic Biological Station at St. Andrews, the Chesapeake Biological Laboratory, the University of Washington Oceanographic Laboratories, and the New York Aquarium; the Naples Zoölogical Station, the Marine Biological Laboratory at Plymouth, the Bermuda Biological Station, the Bergens Museum Biologiske Stasjon, the Pacific Biological Station at Nanimo, and the Misaki Marine Biological Station at Kanagawa-ken. The remaining 49 per cent came from various university laboratories and may in part have been based on work done here or at other marine stations. This distribution conforms well to the principles discussed above.

While the bulk of the material in the *Bulletin* consists of original articles, some attempt was made a few years ago to print the lectures given at the Laboratory. Because of the difficulty in securing the manuscripts and also because of the general pressure for space, this practice was discontinued. The publication of reviews has not been made a feature of the *Bulletin* and there is probably no reason why it should in view of the special journals now devoted to this purpose. An occasional paper bringing together material of particular local interest would be of value to workers in the Laboratory. I have in mind as an example Dr. Harvey's paper on "Physical and chemical constants of the egg of Arbacia punctulata" (*Biological Bulletin*, April, 1932). The promise that preliminary statements of important results would be made a special feature of the *Bulletin* is now fulfilled by the publication of abstracts of the papers delivered at the scientific meetings during the summer.

The prospectus continues:

> There is in America no journal that takes the place of the *Biologisches Centralblatt* or the *Anatomischer Anzeiger* in Germany, although there is abundance of material to support such a publication. It is hoped that the Bulletin may occupy this field, and meet the need for rapid publication of results; the editors, therefore, undertake to issue one number each month, making two volumes a year, if the material offered is sufficient.

At the time the *Bulletin* was founded, the American journals participating in its field were: the *Journal of Morphology*, the *American Journal of Physiology*, the *Annals of Botany*, the *American Naturalist*, the *Botanical Gazette* and the *Journal of Comparative Neurology*. The establishment shortly thereafter of the *Anatomical Record*, the *American*

Journal of Anatomy and the *Journal of Experimental Zoölogy*, and the subsequent appearance of many others has largely eliminated this special raison d'etre. The hope that the *Bulletin* might meet the need for rapid publication of results has not always been fulfilled, for it was recorded in the twenty-seventh report, for the year 1924, that ". . . . lately, in common with many other biological research journals, it had been falling behind in promptness of publication so that about a year elapsed between the receipt of manuscripts and their appearance in print." In the hope of correcting this situation the *Bulletin* was enlarged to 900 pages and the subscription price increased from $6.00 to $9.00 per year, and the fees of members of the Corporation were increased proportionately. This change reduced the time required for publication to at most six months. At the present time the *Bulletin* is run on the theory that the only way to ensure prompt publication is to accept for publication no more papers than one can afford to publish at once. A journal operating on a fixed income has no more chance of catching up with an accumulation of papers it cannot afford to publish at once than does a man in like circumstances who has allowed himself to get some months behind in paying his bills. It is better to require a few papers less suited to one's purpose to find a publisher elsewhere than to delay the entire stream of publication chronically. During the past 11 years no paper has remained in the editor's hands more than two months before going to the printer except under special circumstances, as when occasionally delays occur in securing the necessary reports from referees. In order to facilitate this practice, it is customary not to arrive at a decision concerning the disposition of any paper until the accumulated material can be considered together at the time of going to press.

The *Bulletin* was originally offered at a price of $3.00 per volume of 300 pages. It is interesting to note that this is exactly the cost to the subscriber per page of the present issues. Because of the low price, the length of articles was originally limited to 25 pages and lithographic prints were excluded. The cost of illustrations above $10 was charged to the author. These limitations are no longer exactly exercised, though, naturally, longer papers must be discouraged if opportunities for publication are to be widely distributed. The criterion is that no paper should be longer than is necessary to adequately present its contribution and short and long papers alike should be scrutinized from this point of view. This is sometimes an unwelcome task, but on the whole, I have found our contributors uncommonly co-operative and good-natured. They can usually be made to appreciate that concise presentation is read[illegible] understanding. It is no longer the practice to charge authors for a part of the [illegible] of necessary illustration provided they are content with line cuts and halftones [illegible]nd comply with the general principles discussed above.

The prospectus closes:

"The *Bulletin* will undoubtedly meet a real need; but the responsibility for its success rests with American biologists, and the editors, therefore, confidently appeal to them for their support. This can most practically be given in the two forms of subscriptions and contributions to its pages." The need for the *Bulletin* and its success, as well as the support which it has received from American biologists, is amply attested by its contents. The Index which was published at the completion of Volume LX listed approximately 1200 titles. An index which is now being prepared of the last 20 volumes records an additional 660 titles of original articles and 652 titles of abstracts, making a total of some 2500 contributions. An examination of the original

articles appearing between 1930–1940 showed that 40 per cent of these were written by members of the Corporation. The list of Corporation members contains very few productive workers in fields appropriate to the *Bulletin* who are not contributing to its pages.

On the financial side, the *Bulletin* is supported in three ways. Of 1100 subscriptions, 300 go to members of the Corporation in return for their membership fees. The remaining subscriptions are divided about equally between paid subscriptions from libraries and exchanges. The treasurer's reports show that with this support the *Bulletin* just about breaks even or sometimes shows a small profit. This is due in a sense to the accountant's art and requires a word of explanation. The income from exchanges represents a transfer of Library funds to the *Bulletin* in payment for issues used to secure exchanges. Thus, in a sense, the Library helps to subsidize the *Bulletin* and the sum involved does not represent cash income. In return, however, the Library receives 656 items in exchange, or approximately one-half of its current list of periodicals. It is this fortunate association of the *Bulletin* with the Library which enables it to make ends meet. The large number of exchanges greatly widens the distribution of the papers published in the *Bulletin*.

Respectfully submitted,

Alfred C. Redfield,
Managing Editor [1930–1940].

APPENDIX TO CHAPTER IX

IX, A, 1

Act of incorporation of the Woods Hole Oceanographic Institution.

THE COMMONWEALTH OF MASSACHUSETTS

BE IT KNOWN That whereas

Ralph G. Boyd, Elizabeth D. Peabody,
Charles F. Dunbar, William E. Hays,
E. Curtiss Mower, Jr., Bertha A. Patten
and E. Louise Malloch

have associated themselves with the intention of forming a corporation under the name of the

WOODS HOLE OCEANOGRAPHIC INSTITUTION,

for the purpose of the following:—To prosecute the study of oceanography in all its branches; to maintain a laboratory or laboratories, together with boats and equipment and a school for instruction in oceanography and allied subjects; to accept and hold money, and property of any kind whatsoever, and wherever situated, and whether received through bequest, devise, gift or otherwise; and to apply from time to time and at any time to the purposes of the corporation, or to any of them, all or any part of the income and/or principal of any funds and/or property held by the corporation; and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the

Proper Officers

of said corporation, duly approved by the Commission of Corporations and Taxation and recorded in this office:

NOW, THEREFORE, I, Frederick W. Cook, Secretary of the Commonwealth of Massachusetts, DO HEREBY CERTIFY that said

Ralph G. Boyd, Elizabeth D. Peabody,
Charles F. Dunbar, William E. Hays,
E. Curtiss Mower, Jr., Bertha A. Patten
and E. Louise Malloch,

their associates and successors, are legally organized and established, and are hereby made, an existing corporation under the name of the

WOODS HOLE OCEANOGRAPHIC INSTITUTION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions, which by law appertain thereto.

WITNESS my official signature hereunto subscribed, and the Great Seal of The Commonwealth of Massachusetts hereunto affixed, this sixth day of January in the year of our Lord one thousand nine hundred and thirty.

[*Signed*] F. W. COOK
Secretary of the Commonwealth

(L.S.)

IX, A, 2

Original by-laws of the Woods Hole Oceanographic Institution, 1930.

BY-LAWS

Article I

Officers and Their Election

Section 1. Officers. The officers of the corporation shall be a Board of Trustees, a Director, a Treasurer and a Clerk (none of whom need be incorporators or members of the corporation), a President, who shall be chosen always from the Board of Trustees, and such other officers as the Board of Trustees may from time to time appoint. Any two or more of the offices of Director, Treasurer, Clerk and President may be held by the same person. The Director, Treasurer and Clerk shall be ex officio members of the Board of Trustees additional (except when Trustees by election also) to the members of such Board elected pursuant to the provisions of the following paragraph.

Section 2. Elections. The incorporators shall elect three Trustees and these three, together with such additional persons, if any, as at the time of such election are already Trustees ex officio, shall constitute the first Board of Trustees. The Board of Trustees may from time to time prior to the first annual meeting of members of the corporation, to be held in 1930, elect additional Trustees to a number not exceeding in the aggregate twenty-one (21), and, subject to the limitation aforesaid, the Trustees present at any meeting of the Board, if constituting a quorum of the Board as it existed at the beginning of the meeting, may elect any number of additional Trustees, notwithstanding that none of the persons elected at the meeting were present to participate in any of its proceedings. At said first annual meeting twenty-four (24) Trustees shall be chosen, who shall be divided into four classes, each consisting of six (6) persons, to serve one, two, three and four years respectively, and thereafter at each annual meeting of members of the corporation, six (6) Trustees shall be elected to hold office for the term of four (4) years. The Trustees chosen pursuant to the provisions of this paragraph prior to said first annual meeting shall hold office until said annual meeting, and until a new Board shall be elected as in this paragraph provided. The Trustees chosen at said annual meeting, or at any subsequent meeting of members of the corporation shall hold office until the end of the period for which they are elected and until their successors are chosen.

The first Treasurer and first Clerk shall be elected by the incorporators and shall hold their respective offices until said first annual meeting and until their respective successors are elected and qualified. At each annual meeting of the members of the corporation said members shall elect a Treasurer and a Clerk, who shall hold their respective offices until the next annual meeting and until their respective successors are elected and qualified.

The President and the Director shall be from time to time elected by the Board of Trustees and each shall hold his office until the Trustees shall have voted to terminate his tenure thereof or shall have elected his successor.

The election of all officers herein designated by title shall be by ballot. Any officer may resign by presenting a written resignation to the President, Clerk, or Board of Trustees, such resignation to take effect at the time therein indicated.

Section 3. Vacancies. Every vacancy occurring in the Board of Trustees as at any

time constituted prior to said first annual meeting may be filled by the Board of Trustees at any meeting and the person chosen to fill such vacancy shall hold office until said first annual meeting and until a new Board of Trustees shall have been elected.

Every vacancy occurring in the Board of Trustees after the election of the four classes of Trustees, as hereinbefore provided, may be filled by the Board of Trustees at any meeting and the person chosen to fill such vacancy shall hold office until the expiration of the term for which his predecessor was elected and until his successor has been elected.

Every vacancy occurring in the office of Treasurer or of Clerk may be filled by the Board of Trustees and the person chosen to fill such vacancy shall hold office until the next annual meeting of the members of the corporation and until his successor is chosen and qualified.

Article II

Members' Meetings

Section 1. Annual Meetings. The Annual Meeting of the members of the Corporation shall be held at the office of the corporation at Woods Hole, Massachusetts, or at such other place in Woods Hole as the Trustees may have designated as a place for holding such meetings, on the Thursday following the second Tuesday in August of each year, at twelve o'clock, noon.

Section 2. Special Meetings. Special Meetings of the members of the corporation may be called by the Trustees, to be held respectively at such places in Woods Hole or Boston, Massachusetts, and at such times as the respective calls may designate.

Section 3. Quorum and Voting. At any meeting of the members of the corporation a majority of the then members of the corporation, if present in person or by proxy, shall constitute a quorum for the transaction of business. For the purposes of all elections and other matters left to the decision of the members of the corporation each member shall be entitled to one vote.

Section 4. Proxies. All proxies shall be in writing signed by the members giving them.

Section 5. Adjournments. Reasonable adjournments may be made from time to time of any meeting of the members of the corporation.

Section 6. Notices. Notice of the time and place of every meeting of members of the corporation shall be served on each member by the Clerk, or by some officer of the corporation authorized by the Trustees to serve such notices, by delivering to him personally or mailing, postage prepaid, addressed to him at his address registered on the books of the corporation (or, in the case of a member who has no recorded address, at his last known address) a written or printed notice, not less than ten (10) days before the day fixed for the meeting. Notices of special meetings of the members shall state the purposes thereof.

Article III

Trustees' Meetings

Meetings of the Board of Trustees shall be held at such place within or without Massachusetts as may from time to time be fixed by resolution of the Board, or as may be specified in the call of any meeting. Meetings of the Board may be held at any time upon call of the President or any two (2) Trustees made by giving notice (or causing notice to be given by the Clerk or the Secretary, if any, or by any other person) to each Trustee (other than the person or persons making the call) of the time

and place of the meeting, written or printed and mailed to his last known address, postage prepaid, at least three (3) days before the day of the meeting. Seven (7) Trustees (or, at any time when there are in office less than thirteen (13) Trustees, a majority of the Trustees then in office) shall constitute a quorum for the transaction of business. In all matters to be acted upon by the Board of Trustees, each Trustee, regardless of whether he holds that office by reason of election thereto, or by reason of holding one or more other offices, or for both said reasons, shall be entitled only to one vote.

Article IV

Powers and Duties of Officers

Section 1. President. The President when present shall preside at the meetings of the Board of Trustees and of the members of the corporation.

Section 2. Treasurer. The Treasurer, subject to the control of the Trustees, shall have custody of the money and books of account of the corporation and keep full, regular and accurate accounts of the financial transactions of the corporation and keep the funds of the corporation other than permanent funds invested in investments legal in one or more states for the investment of trust funds.

Section 3. Clerk. The Clerk, who shall be a resident of Massachusetts and be sworn to the faithful performance of his duties shall keep a true record of all meetings of the Board of Trustees and of the members of the corporation at which he is present. In his absence from any meeting a Clerk pro tempore shall be chosen and need not be sworn.

Section 4. Trustees. The Trustees shall have the control and management of the property and affairs of the corporation. Subject only to the foregoing provisions of these By-Laws they may choose such officers and agents as they think best, fix the compensation and define the powers and duties of all officers and agents and at any time remove them, or any of them, from office. They shall cause a report of the condition of the corporation to be presented at each annual meeting of the members of the corporation.

Article V

Members of the Corporation

The Board of Trustees may from time to time elect members to the corporation upon such terms and conditions as they think best. The Incorporators shall not be deemed members of the corporation and shall not be entitled to receive notice of or to vote at any of the meetings of members of the corporation provided for in *Article II* hereof.

Article VI

Executive Committee

The Board of Trustees may at any time and from time to time designate an Executive Committee, to consist of three (3) or more of the Trustees, as the Board may from time to time determine. The Executive Committee shall have such of the powers of the Board of Trustees as the Board may from time to time delegate to it. Said Committee may make such rules as it sees fit for the conduct of its business.

Article VII

Corporate Seal

The corporate seal shall be circular in form and have inscribed therein the following:—Woods Hole Oceanographic Institution Massachusetts 1930.

ARTICLE VIII

These By-Laws may be from time to time in any manner altered by the Board of Trustees, at any meeting thereof, provided that the notice of the meeting states that an alteration of the By-laws is to be acted upon.

IX, A, 3

TRUSTEES OF THE WOODS HOLE OCEANOGRAPHIC INSTITUTION AS OF JANUARY 1, 1941

TO SERVE UNTIL 1944

HENRY B. BIGELOW, Museum of Comparative Zoölogy, Cambridge, Mass.
A. G. HUNTSMAN, University of Toronto, Toronto, Canada.
ALFRED C. REDFIELD, Harvard University, Cambridge, Mass.
HENRY L. SHATTUCK, 50 Federal Street, Boston, Mass.
T. WAYLAND VAUGHAN, 3333 P Street, Washington, D.C.

TO SERVE UNTIL 1943

ISAIAH BOWMAN, Johns Hopkins University, Baltimore, Md.
E. G. CONKLIN, Princeton University, Princeton, N.J.
ROSS G. HARRISON, Yale University, New Haven, Conn.
THE HYDROGRAPHER (Captain G. S. Bryan), U.S. Hydrographic Office, for the time being, Washington, D.C.
FRANK R. LILLIE, 5801 Kenwood Avenue, Chicago, Ill.
HARLOW SHAPLEY, Harvard University, Cambridge, Mass.

TO SERVE UNTIL 1942

CHARLES FRANCIS ADAMS, 15 State Street, Boston, Mass.
THOMAS BARBOUR, Museum of Comparative Zoölogy, Cambridge, Mass.
JOHN A. FLEMING, Carnegie Institution, Washington, D.C.
FRANK B. JEWETT, 195 Broadway, New York, New York.
ALBERT E. PARR, Bingham Oceanographic Foundation, New Haven, Conn.
ELIHU ROOT, JR., 31 Nassau Street, New York, N.Y.

TO SERVE UNTIL 1941

THE COMMANDANT (Admiral R. R. Waesche), U.S. Coast Guard, for the time being, Washington, D.C.
MARION EPPLEY, The Eppley Laboratory, Inc., Newport, R.I.
LAMAR R. LEAHY, U.S. Navy, Retired, Catherine Street, Newport, R.I.
T. H. MORGAN, California Institute of Technology, Pasadena, Calif.
THE DIRECTOR (Admiral L. O. Colbert), U.S. Coast & Geodetic Survey, for the time being, Washington, D.C.
B. W. ST. CLAIR, 10 Arrow Street, Cambridge, Mass.

EX OFFICIO

COLUMBUS O'D. ISELIN, Woods Hole Oceanographic Institution, Woods Hole, Mass.
LAWRASON RIGGS, JR., 120 Broadway, New York, N.Y.

Officers

Henry B. Bigelow, President of the Corporation, Museum of Comparative Zoölogy, Cambridge, Mass.

Lawrason Riggs, Jr., Treasurer, 120 Broadway, New York, N.Y.

Columbus O'D. Iselin, Clerk of the Corporation, Woods Hole Oceanographic Institution, Woods Hole, Mass.

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WOODS HOLE OCEANOGRAPHIC INSTITUTION

STAFF

(As of December 31, 1941)

Columbus O'D. Iselin, Associate Professor of Physical Oceanography, Harvard University, and Assistant Curator of Oceanography Museum of Comparative Zoölogy; Director.

Cornelia L. Carey, Assistant Professor of Botany, Barnard College; Associate in Marine Bacteriology.

George L. Clarke, Associate Professor in Biology, Harvard University; Marine Biologist.

William Maurice Ewing, Associate Professor in Geophysics, Lehigh University; Associate in Submarine Geology.

Bostwick H. Ketchum, Associate in Marine Biology.

Raymond B. Montgomery, Lecturer on Maritime Meteorology and Oceanography, Assistant Professor of Meteorology, New York University; Physical Oceanographer.

Albert E. Parr, Director of Peabody Museum and Curator of the Bingham Oceanographic Collection, Yale University; Associate in Oceanography.

Fred B. Phléger, Jr., Associate Professor of Geology, Amherst College; Submarine Geologist.

Norris W. Rakestraw, Associate Professor of Chemistry, Brown University; Chemical Oceanographer.

Alfred C. Redfield, Professor of Physiology, Harvard University; Associate in Marine Biology.

Charles E. Renn, Tutor in Biology and Instructor in Sanitary Engineering, Harvard University; Associate in Marine Bacteriology.

Gordon A. Riley, Marine Biologist, Yale University; Marine Physiologist.

C. G. Rossby, Professor of Meteorology, Massachusetts Institute of Technology, and Assistant Chief, U.S. Weather Bureau, Washington, D.C.; Associate in Physical Oceanography.

Mary Sears, Instructor in Zoölogy, Wellesley College; Planktonologist.

H. R. Seiwell, Physical Oceanographer.

Floyd M. Soule, Principal Physical Oceanographer, U.S. Coast Guard; Associate in Physical Oceanography.

Athelstan F. Spilhaus, Associate Professor of Meteorology, Chairman of the Department of Meteorology, New York University; Physical Oceanographer.

Henry C. Stetson, Research Associate in Paleontology, Museum of Comparative Zoölogy; Submarine Geologist.

SELMAN A. WAKSMAN, Microbiologist, New Jersey Agricultural Experiment Station; Marine Bacteriologist.

EDMOND E. WATSON, Assistant Professor of Physics, Queen's University; Physical Oceanographer.

DEAN F. BUMPUS, Biological Technician.

EUGENIA P. LAMBERT, Geological Technician.

ELIZABETH ORR, Chemical Technician.

HELEN F. PHILLIPS, Secretary to the Director.

CHARLES W. WEISS, Bacteriological Technician.

ALFRED H. WOODCOCK, Oceanographic Technician.

WILLIAM C. SCHROEDER, Business Manager.

ETHELYN T. BIRD, Secretary.

BARBARA FERGUSON, Assistant Secretary.

WILLIAM SCHROEDER, Superintendent of Buildings and Grounds.

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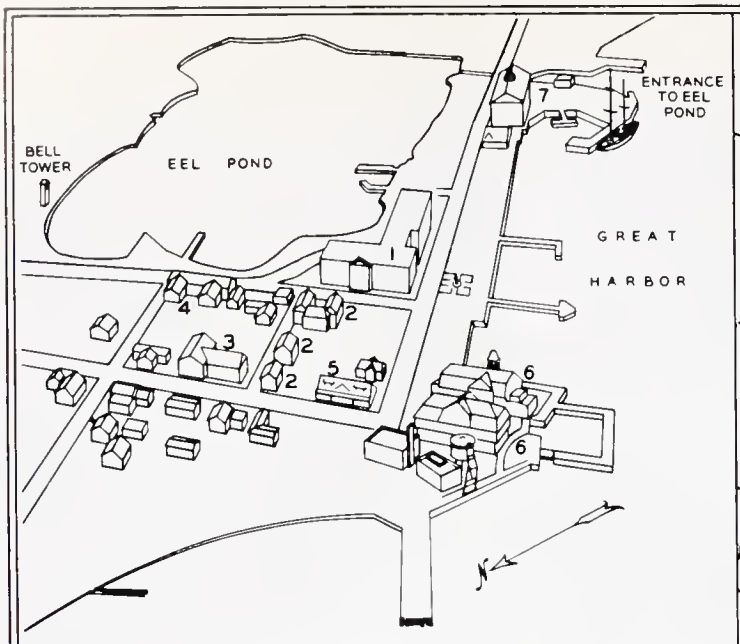

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MARINE BIOLOGICAL LABORATORY

1. MAIN LABORATORY
2. OLD LABORATORIES
3. APARTMENT HOUSE
4. DORMITORY
5. MESS HALL

OTHER LABORATORIES

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7. WOOD'S HOLE OCEANOGRAPHIC INSTITUTION (BUILDINGS, WHARVES AND ATLANTIS).

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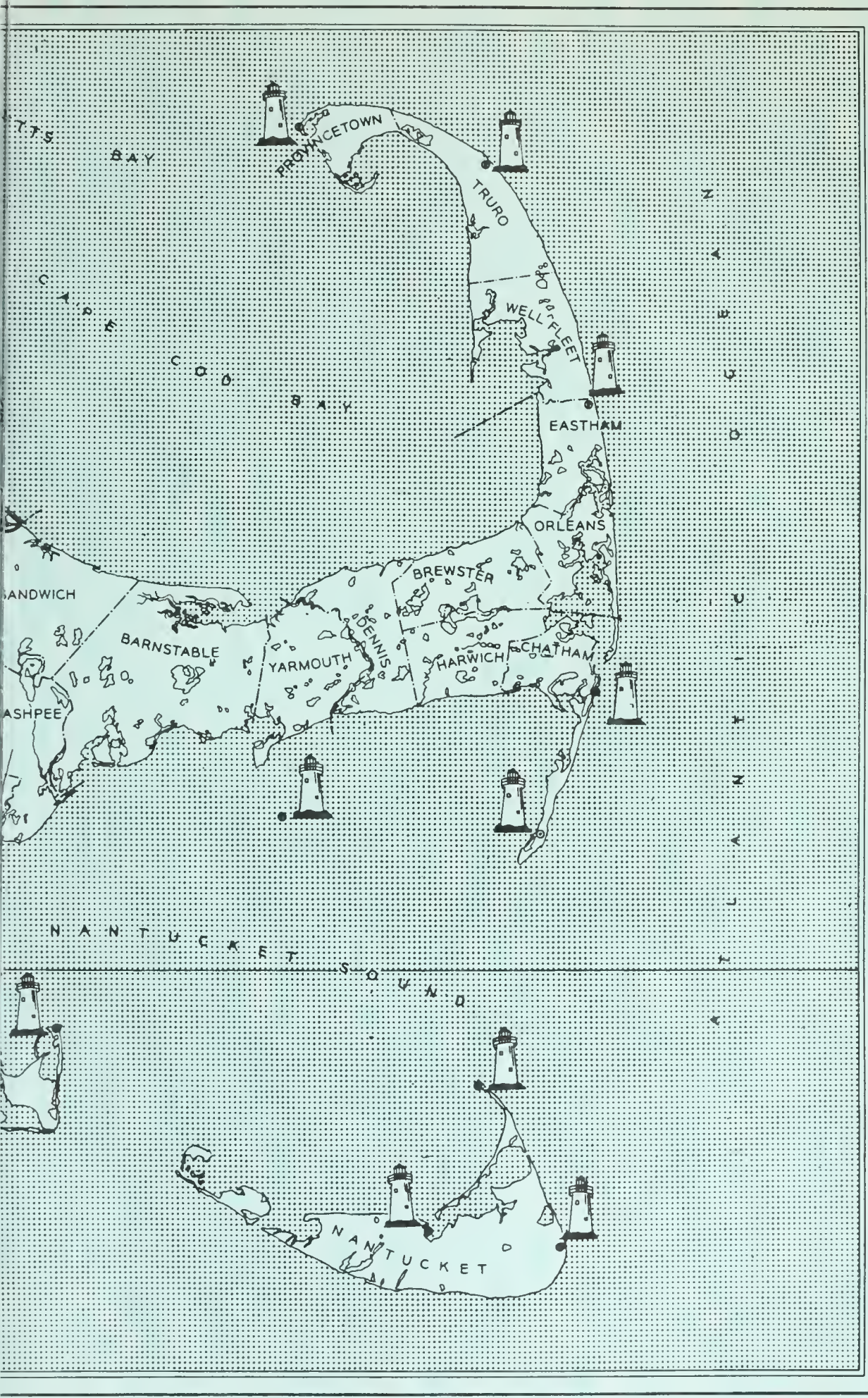
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